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Tunkhannock Viaduct in Service

THE Delaware, Lackawanna & Western Railroad plans to shift its trains to-morrow to the Tunkhannock viaduct. The progress of the work on this mammoth structure has been followed by a series of articles in this journal, the last appearing July 10, on page 42, when a number of views of the nearly completed bridge were shown. The 2375-ft. viaduct, 240 ft. high, is only one feature of the Nicholson cut-off, the purposes of which were set forth in the Engineering Record of April 26, 1913, page 461, by G. J. Ray, chief engineer of the Lackawanna. The new line, located in northeastern Pennsylvania between Clarks Summit and Hallstead, is 39.6 miles long. Besides shortening the road 3.6 miles, it eliminates 2440 deg. of curvature and reduces the ruling grades from 1.23 and 0.52 per cent, uncompensated, eastbound and westbound, respectively, to 0.68 and 0.237 per cent. The economic value of the reduction in grades is the greater because the remainder of the 115-mile operating division between Scranton and Elmira, N. Y., with the exception of a pusher grade out of Scranton to Clarks Summit, has limiting grades each way of about 12 ft. per mile. The new line eliminates westbound pushers west of Clarks Summit, and fits the eastbound grades to the lighter ones west of Hallstead so that a train brought to Hallstead by any class of engine can be moved on to Scranton with the aid of a pusher of the same class. Coming so closely after that other great and perhaps more spectacular cut-off of the Lackawanna—the Hopatcong—this latest improvement testifies again to a progressive management blessed with funds to build for the future.

A Rate Revision Upward

IN the rate case of the Peoples Natural Gas Company of West Seneca, N. Y., decided last week by the State Public Service Commission, the unusual feature was that the town authorities waived the provisions of a franchise which limited the price the company could charge for gas to 25 cents per 1000 cu. ft., thus allowing the commission to sanction an increase of rates to 32 cents. It is an easy matter for any public utility commission to receive the public's solid backing in any program involving a revision of rates downward, but a proposal for higher charges is never received with much enthusiasm. It must be realized, however, that State commissions have a double duty to perform. They are, as Commissioner D. P. Hodson stated in his opinion, under obligations to conserve the interests of the company as to income and benefits quite as much as to protect the rights of the public as to rates and service. Justice can not permit, much less require, a corporation to conduct its business at a loss. Earnings, in order to be reasonable, must be large enough to provide sufficient funds to pay all operating expenses and fixed charges and to cover also such proper amounts for interest, profit and depreciation as can be regarded fair under the circumstances of the case. In the end this principle must govern if the mutual interests of the public and the utilities are to be served.

Architectural Features in Design

ENGINEERS in this country should exert more influence in the development of architecturally pleasing effects in the design of structures than they have done in the past. Frequently the pressure brought to bear upon them by owners or officials of corporations and municipalities who control the design of engineering construction and insist upon mere utility and, sometimes, upon lowest first cost, is hard to resist. It is encouraging to note cases in which this pressure has been successfully resisted and overcome. In the case of the Glens Falls bridge, described on page 574, it is seen that the expenditure of a little thought on effective details requiring the addition of a small percentage of the cost has resulted in a structure of striking appearance. Engineering work should not be wholly utilitarian. In all cases where natural surroundings require it, where the consistent development of a great architectural plan is possible, or where the presence of appreciative observers is probable, the element of general architectural appearance should be given consideration. We are still far behind European engineers in this respect. Surely the great natural wealth of this country can be better applied in this direction than we have yet succeeded in applying it.

Cuban Sugar Plantations

PROSPERITY such as they have not known in many years has befallen the Cuban sugar plantations. The good crop and high prices of last year and the prospect of even greater returns during the coming season have caused a marked revival of construction activity in the sugar-growing industry. New plantations to a value of several million dollars are projected or actually under construction, established mills are contemplating additions and extensions, and numerous promoters are seeking capital to develop hitherto untouched territory. That the American engineer could find in this activity a profitable field cannot be gainsaid. A consideration of the kinds and magnitude of construction that enter into the establishment of a modern plantation, such as the one described on page 534 of last week's issue, will demonstrate that the field is well worthy of attention. Cuba has need of technically trained men. Even in dull times it has not been able to find a sufficient number of such men among the natives to supply the demand. There is work for the American engineer to do in Cuba and the terms of renumeration are generally liberal. In return he can do much for the island. Very few of its plantations have been compelled to cultivate intensively, to increase the cane-growing life of the individual acre and to get the maximum return from it. New land has hitherto been too cheap and near at hand. Agriculture has been destructive rather than conservative. But, in time, such conditions must change. The virgin lands of the island are being encroached upon more and more each year. The man who devises a cheap way of restoring the vitality of the old lands and demonstrates to the cane planters the profit that lies in such restoration will render a very great service.

Appreciation of the Engineer

IN large public works the daily press is always on the lookout for a scandal. Padded estimates, top-heavy payrolls, inferior construction at high prices, and extra work are fair game for reporter and editorial writer. This sort of material makes a "good story," and on some of the yellow journals the standard of practice seems to be never to allow the facts to spoil a good story. For this condition of affairs engineers are in part responsible. They are, or think they are, "too busy" to let the public know about the work under way, and this attitude has been responsible for the all too general belief that there must be some graft connected with every city or State contract. To claim that all public work is clean would indicate an amazing degree of unsophistication, but the stigma of crookedness should not be all-inclusive. In pleasing contrast to the muckraking story is the commendation of the Winnipeg Aqueduct work in a recent issue of the *Manitoba Free Press*, following a public inspection of the work. In an editorial that journal pays high tribute to the civil engineer's part in the project for delivering a new water supply to the Winnipeg district through a 100-mile conduit. This work, to which James H. Fuertes has devoted his energies as consulting engineer, has involved also the building of a standard-gage railroad line, primarily for construction purposes, and the Canadian paper sees in the undertaking not merely a means of securing a better water supply but an opportunity of "opening up a magnificent farming territory, until recently supposed to be nothing better than swamp, muskeg and scrub brush. The road was built as a necessary step toward the aqueduct but now promises to justify itself as an economic venture." With public opinion behind it, the course of the Winnipeg Aqueduct work should be fairly smooth.

Coroner's Jury and Engineer

THE verdict of the coroner's jury which investigated the collapse of subway decking after a blast at Seventh Avenue and Twenty-fourth Street in New York City was at once contradictory and consistent. The findings, which were given in the Engineering Record last week, were consistent in following the expert testimony presented to the jury, and contradictory in their recommendations for future public safety, since contradictory testimony on this point was heard by the jury. The entire circumstance emphasizes again the work the engineer must do to make the laymen understand engineering construction better. When this has been done by proper publicity, public clamor will be directed toward real improvement in methods, where faulty work has attracted public attention through an accident, and will not blindly attack everyone connected with the work on which the accident happened, as is now the case.

The recommendation of the jury that the public be kept off temporary street supports over subway work while blasts are being fired is right in line with the weight of the best engineering testimony presented to it. As has been pointed out by this journal before, the burden of carrying out this suggestion lies with public officials and the general public. The engineers and contractors are already doing all that is in their power.

The paragraph of the finding which censures the Fire Department for not supervising the blasting operations more closely is a good example of what may be expected of a body of average jurymen to whom a misleading instance of work with which they are not familiar is presented. The jury was told of an experimental blast that had been masked with timber mats, which prevented rock fragments from flying, and appears at once to have jumped to the conclusion that such mats would have prevented the accident on Seventh Avenue, and to have blamed the Fire Department for not having compelled the contractors to use them in all cases. The efficacy of such mats in subway work is very doubtful. Successive blasts tear apart the fastenings, and the slightest neglect in inspecting and renewing these would result in hurling down the subway cut where the mat was used a volley of timber missiles much more dangerous than the rock fragments the mat was supposed to confine.

For blasts too large to be covered with woven-rope mats, timber mats have been used on open construction, but the benefit from them is at least doubtful. That an average jury was misled by the presentation of a successful instance, uncontradicted in the general testimony, is, however, not to be wondered at. Those handling the case would have done better to have gone more thoroughly into the subject of covering blasts with such mats, and shown the jury the exact uses and limitations of this practice.

Full-Size Tests to Duplicate Service Conditions

THE importance of tests of full-size members of bridges, buildings, machinery and other structures, the necessity for conducting the experiments so as to subject the member to such stresses as it will sustain in actual use, the need for systematic and well-planned tests, and suggestions of the kinds of tests most needed are vital points in the paper on this subject by Gaetano Lanza of Philadelphia presented before the International Engineering Congress at San Francisco, in September. There should be further co-operation and systematic organization in the making of such tests, the necessity for which is emphasized by Mr. Lanza. Such co-operation as is conspicuously in evidence in the comprehensive series of full-size column tests now being made by the U. S. Bureau of Standards under the auspices of the committees of the American Society of Civil Engineers and the American Railway Engineering Association is of the utmost value. This co-operation should take place among university laboratories, experiment stations, industrial works and government bureaus, and should insure comprehensive series so arranged as to determine experimentally the effect of the alteration of each of the variable factors in the given problem.

In the issue of May 8, 1915, page 574, the point made by Mr. Lanza, that experimental tests should duplicate actual conditions as nearly as possible, has already been emphasized by this journal in connection with the series of column tests above mentioned. Too wide a departure from usual working materials and practice in the fabrication of test pieces is to be deplored, even though the arguments for scientific exactness and control be strong.

Mr. Lanza divides the tests most needed into two general classes, those on members employed in bridges and buildings and those on pressure vessels and parts of various kinds of machinery. The civil engineer is directly interested only in the first class, and among the more important recommendations for tests are: Built-up columns for buildings and bridges, with especial reference to effect of details, eccentric loading and ratio of yield point to crushing strength of the material; tests of full-size columns of heat-treated and alloy steels; I-beam tests for variation in both yield point and ultimate strength with form of section; repeated and alternate stresses, which need to be investigated much more thoroughly than in the past, and impact tests, which should be placed upon a more scientific basis, with study of the effect of the nature of the impact machine, its foundations and the supporting ground.

The recent developments in the use of alloy steels, as presented by J. A. L. Waddell in his paper before the International Congress, abstracted on page 386 of the issue of Sept. 26, strongly emphasize the necessity for full-size tests of these materials, as is also recommended by Mr. Lanza. This necessity is particularly evident in the case of vanadium steel and Mayari steel to determine the actual strength values of fabricated members of full size to prove whether or not such high-strength material is, at the same time, ductile and tough enough to withstand practical shop fabrication without injury.

Exploitation's Reaction and Its Moral in Latin America

NORTH AMERICAN capital has at last awakened to the possibilities of South America, Central America and the West Indies. Large banks in this country are establishing branches there and our manufacturers are planning to adapt the patterns of their products to the standards of the countries wherein they expect to sell them, and to go after their trade aggressively. A painstaking effort is being made to gain an understanding of the attitude and susceptibilities of the Latin-American peoples so that we may work in harmony with them to mutual advantage, instead of merely insulting them as we have done in the past. With American money and American products will go the American engineer, and, later, the American contractor. Such was the program in Cuba after the Spanish-American War and there is little doubt that it will be followed in this new and greater field. It is to be hoped, however, that this latest expansion of American influence will not, after a very few years, result in the same loss of reputation and distrust of everything American that resulted from the exploitation of Cuba.

We hear much of the necessity of establishing branch banks, of giving long credits, of adapting ourselves to Latin-American ways and of being able to speak and correspond with those with whom we deal in their own language. But one essential is apparently overlooked, and, unless we wish to stand in the broader field in the near future as we stand in Cuba to-day, that essential must be considered above all others. The American reputation for honesty must be rigidly maintained. The dishonest few who would sully it must be entirely eliminated. This was not done in Cuba, with the result that those few—and their number was very small indeed—undid much of the good work that had been accomplished, and went a long way toward ruining American prestige for many years to come. Our works in Cuba, in total, entitle us to appreciation and respect instead of distrust.

Even so late as seven years ago the American engineer who went to Cuba was a fortunate individual. In the first place, engineering in that country is on a par with, if not actually held in higher esteem than, any other profession. In addition to this the work of American engineers and contractors on the construction of the Palatino reservoir and the water distribution system of Havana, in Spanish times, and their services immediately after the Spanish-American War, including the planning of the Havana sewer system, the cleaning up of that city, the elimination of yellow fever, and the transforming of an ugly, dog-tooth coral shore, on which the seas at high tide deposited a good part of the city's refuse, into a widely known Malecon which is now the show place of the city, made the word American a highly regarded prefix.

American contractors, too, were esteemed for their honesty and admired for their efficiency. Small firms were organized in the early days of American influence and grew large and opulent, but not through dishonesty. Construction was on a boom, and they took advantage of the opportunity. Profits were proportionately large, but no one begrudged their size so long as the work was well done.

The dishonest ones were undoubtedly at work even in those days, but they did not come prominently to the fore until the Intervention, some four years later. When they had finished their work little was left of the reputation of the American engineer, promoter and contractor.

There are still opportunities in Cuba for American engineers and contractors. The country's sugar plantations and other works demand a large number of men of professional education and training. There is a marked deficiency of such men among the natives, so that the American is still welcomed. But his honesty and efficiency are no longer taken for granted. He must prove himself. So it will be in the new field that seems about to be opened up. Its full value will never be realized unless the carpet-baggers are mercilessly weeded out.

National Parks as an Asset

NATIONAL PARKS may be an asset or a liability, just as the policy of management may be sane and business-like or shortsighted and indifferent. It has taken a long time and a good deal of agitation to induce the Federal Government to change its policy in handling national park affairs, but now that this has come about, as outlined on page 568, it is fair to expect that the proposed plan will be backed up adequately and pushed through to completion without unnecessary delay.

The profits which it is estimated this country will enjoy when the chain of national parks is adequately equipped and advertised are rather staggering, and the first thought is a question as to whether the figures have not been placed too high. However, no reason is apparent for discounting figures which the new general superintendent of national parks bases on a detailed study of the entire problem, and the new policy of constructive management has much in its favor. Under the proposed plan of financing no government appropriations for what might be classed as business ventures will be required; such funds as the department will need to spend on the parks will be chiefly for substantial improvements, such as roads and trails. The plan for chalet construction requires the concessionaire to furnish the capital, but offers him the safety of government backing in his investment, at the same time he is left free to use his initiative and business ability in operating his property.

Under the terms of the grant the concessionaire will become virtually a copartner with the government and in this point is the secret of success which the scheme promises. When financial or operating difficulties arise it will be mutually desirable for concessionaire and government agent to study the matter together, thus putting at the disposal of any concessionaire the benefit of experience in each of the other parks. From the standpoint of the government it will be less expensive and in many ways more satisfactory to help the concessionaire over his difficulties than to insist that he either conform strictly to the letter of the contract or suffer eviction. The new policy will be heartily approved by engineers the country over, and it would be well indeed if there were assurance that equally sane and business-like views would be applied consistently in all government problems with which the engineer is closely identified.

Making the Contractor the Scapegoat for Engineering Inefficiency

THIS JOURNAL has received a copy of specifications of the sort that should have gone out of fashion long ago. They will deter any responsible parties from bidding on the work, and will cause trouble for the owner, the engineer who was ignorant enough to prepare them and any contractor foolish enough to sign a contract which includes them. It seems that repeated condemnation on the part of those interested in good work and fair dealing has no effect on certain persons with a quasi standing as members of the engineering profession. Cannot contractors solve the matter by refusing to bid on specifications of this sort, and forcing their authors to deal with irresponsible bidders until these men or their clients have learned this lesson so that it will not be forgotten?

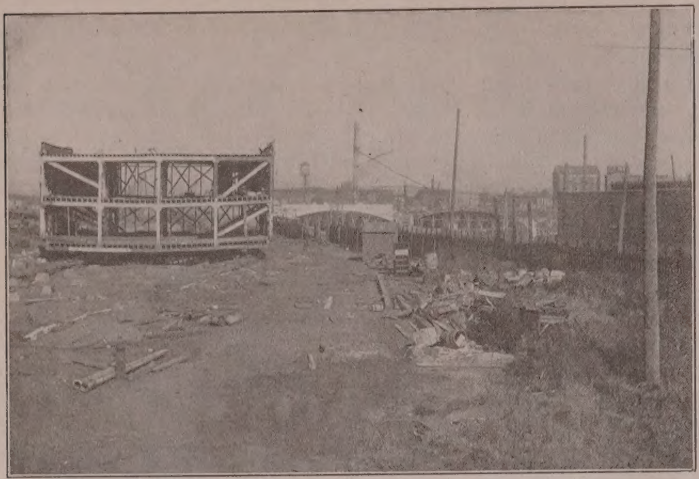
The phrase "to the satisfaction of the engineer" occurs constantly in the document, and is used as a lazy substitute for stating in plain English what the engineer wants and how he proposes to get it. The specifications provide that the engineer may take charge of the job with his own crew and mix and place concrete at the contractor's expense, at the engineer's discretion. If the engineer doubts the ability of a contractor to do concrete work when the contractor understands what is wanted, he is betraying the trust of his client to enter into an agreement with that contractor. Or does the engineer doubt his own ability to get any contractor to do what he wishes?

These specifications contain the outgrown provision that bids by other contractors may be invited for any extra work in connection with the contract, in case the contractor and the owner cannot speedily agree on the payment for such extra work. A definite provision for payment for extra work at cost plus per cent, or according to some other approved method, is always preferable to this clause. Furthermore, interpreted in accord with the general tone of the specifications, any contractor would be justified in assuming that this clause would be held over his head as a club in making prices for extra work.

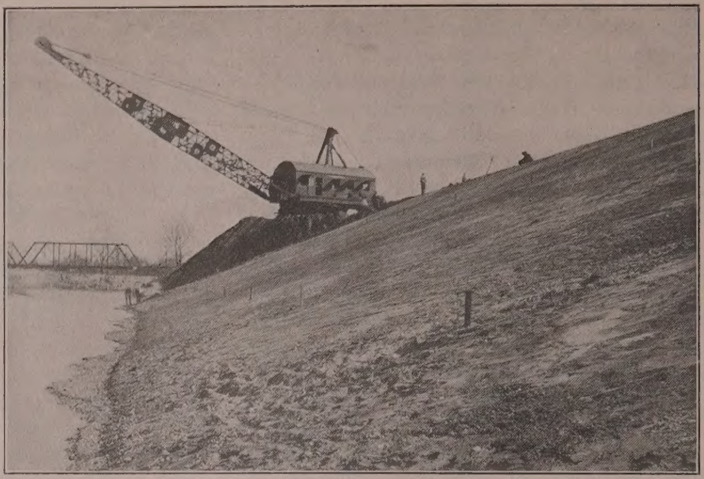
The person who fathered this document further requires that reinforced wall concrete shall be placed in layers 6 in. thick, each thoroughly tamped before another layer is placed. This stamps him as either ignorant of concrete construction, or as seeking to carry out in the field experiments that should be made in the laboratory. The specifications further state that the reservoir walls—the main concrete item, containing about 900 cu. yd.—must be poured continuously, and provides cash penalties for delays due to breakdowns which are so severe as to require duplicate mixing plants. This is an unnecessary expense on such a small yardage, and entirely unwarranted in view of the fact that such a breakdown could have no serious effect on the finished wall if any of several methods for bonding the old and new concrete were used. These methods would be much cheaper than the extra expense necessary to insure continuous pouring, and probably would not even need to be used. This penalty feature for a one and one-half to three-hour breakdown is apparently due to inexcusable ignorance.

The all too usual clause throwing responsibility on the contractor for errors made by the engineer in gathering the data on which bids are asked, is, of course, inserted at the end. The engineer says in effect that he thinks he wants certain things done—certain quantities of certain materials moved, or furnished and placed—but that if the contractor finds that the engineer wants something else the contractor must pay the difference. In normal times an extra and unnecessary sum, added to the bid, comes out of the owner's pocket to pay for this deficiency of his engineer. Either the engineer is not paid enough to make proper investigations of the site, which may be either his fault or that of the owner, or the engineer says, in effect, that he does not know his business and cannot determine the ordinary conditions of the work with enough certainty to predict its approximate cost. The engineer should have the sense and backbone to stand on his design and estimate. If extraordinary conditions, such as could not possibly be predetermined at a reasonable expense, are found, no one can blame the engineer, while the contractor is entitled to be protected against loss. Usually the insertion of this clause merely means that the contractor has to assume the cost of any mistake, however gross, in the engineer's work, although he is seldom given time, and should not be put to the expense of thoroughly checking the engineer's explorations and estimates.

Such specifications as these hurt the engineering profession, municipalities and other owners as well as contractors. All should join to educate the specification writers to a proper conception of what specifications are for.



KINGAN'S COOPER SHOP MOVED IN SECTIONS FROM LEVEE LINE



DRAGLINE FINISHING SLOPE WITH 1½-YARD BUCKET

High Levees Will Protect Indianapolis from Floods

Construction of Earth and Wall Barriers Along White River Involves Rapid Concrete Methods, Large Excavating Units and Riprap Laid on Paper "Shingles"—Channel Velocity Reduced to 10 Feet per Second

THREE OUTFITS, each consisting of an A-frame derrick, a ½-yd. concrete mixer fed by aggregate excavated and screened on the ground, and seven men, are completing each week three 40-ft. base sections for the 2300 ft. of gravity wall on a portion of the West Side White River flood protection at Indianapolis. The contractor receives about $1,100 for the 170 cu. yd. of concrete placed over the forty 21-ft. piles driven into the extremely porous gravel in the bottom of the trench of each section, which is 14 ft. wide and 30.5 ft. deep, measuring down from the natural surface.

The West Side White River flood protection work, when completed, will present an unbroken barrier against future floods 4 ft. higher than that encountered in 1913, on the west side of the river from high ground near Belmont Avenue above Fall Creek, through the heart of the manufacturing and business portion of the city downstream to the Belt Railroad, a total distance of 4½ miles along the new and straightened channel. Surveys of the watershed and flooded areas and subsequent studies following the 1913 disaster, when $7,000,000 damage was sustained, indicated a channel 650 ft. wide and 29 ft. deep must be provided to care for the same intensity of runoff, 120,000 sec. ft. To provide this cross-sectional area some 400 properties had to be acquired on the west side of the river, all bridges lengthened and curves in the present channel straightened out. Wherever feasible a riprapped earth levee with a traffic way on the top, 60 to 75 ft. wide, was planned, but at certain points where unusually valuable improvements encroached on the desired area gravity concrete walls replaced the levee. To withstand the erosion opposite the mouth of Fall Creek a wall was deemed necessary. To have moved the car barns and power plant north of Washington Street was considered prohibitive in cost. The wall alignment cuts close to the power house, the foundation of which was carefully shored up. Subways for the traffic way under the railroads near Kingan & Company's packing plant (see drawing) support the back of the levee and form abutments for the bridges.

South of Oliver Avenue the levee consists of Drover Street elevated to a height of from 12 to 16 ft. above its former elevation. The industries between Drover Street and the river and from Morris Street to Oliver Avenue are being removed to other locations, and the ground upon which they stand will become park lands and river channel. South of Morris Street, the Indianapolis Abbatoir Company feeling that it was able to withstand the onslaught of a flood such as the one of 1913, the levee is continued in Drover Street to the company's south line, then bent east and south to the river bank and again continued south to the Belt Railway embankment.

The special district benefited and assessed for the work on the west side, amounting to $1,300,000, covers an area of 1400 acres valued at from $1,000 to $5,000 per acre. In practically all of this area damages were sustained in 1913. Under the flood law passed last winter this benefit district pays one-tenth the cost of all construction and land acquisition, the city of Indianapolis under a general tax pays 45 per cent and Marion County pays 45 per cent, the benefit district sharing in this 90 per cent according to its assessed valuation in the general taxes.

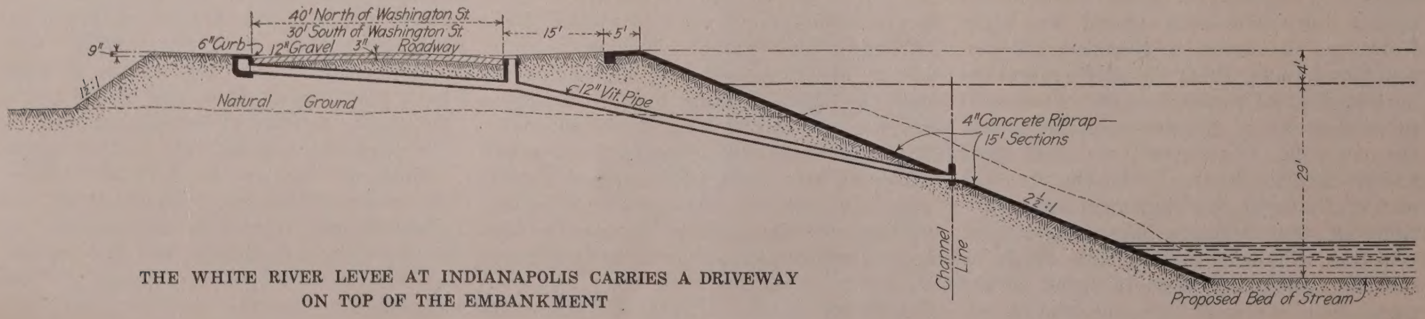
REDUCE FLOOD VELOCITY TO 10 FEET

In connection with lengthening the bridges it is proposed to construct regulating weirs and dams so as to reduce the velocity of the stream and to prevent any scouring at bridges. The velocity of the stream as estimated by the city engineer and verified by the United States Army engineers would be practically 10 ft. per second during extreme floods. This velocity is considered excessive, and some means must be provided to check the current and to prevent the destruction of river structures.

The plan on the east side is to provide a levee and street from Tenth Street south practically parallel with the harbor lines on the west side. The city engineer is of the opinion that this work can be done without much cost to the city by granting to gravel companies the privilege of removing and selling the gravel on condition that the gravel companies will construct the levee and street with the earth stripping. According to the plan, it is proposed to construct subways under the Belt Railroad north of Tenth Street and on the Crawfordsville Road or Park Drive on the east side of the river, and eventually to build a subway under the Belt Railroad near Raymond Street.

EXCAVATION AND LEVEES

Material in the bends cut off by the realignment of the channel provides more than enough material for the levee, but in



THE WHITE RIVER LEVEE AT INDIANAPOLIS CARRIES A DRIVEWAY ON TOP OF THE EMBANKMENT some cases it has to be hauled up to two miles, as in the sub-contract work of the T. A. Kearns Company of Chicago, which is building the 350,000-cu. yd. embankment from the northwest end of the wall near Lansing Street and the street from Washington Street north to Belmont Avenue. Four narrow-gage nine-car trains of 4-yd. Western dump cars are loaded by a 70-ton Bucyrus shovel and handle about 35,000 cu. yd. per month. A Lidgerwood dragline with a 70-ft. boom handling a 1½-yd. bucket travels along the bank and slopes up the levee to the required line for the riprap. Ahead of the dump made by the dirt trains all excess excavation on these slopes is thrown back into the levee prism, the dirt trains completing the fill to the required heights and widths.

Above the Belt Railroad, the above company has been moving 5000 cu. yd. per day directly into the levee with an electric dragline operating a 4½-yd. bucket at the end of a 100-ft. boom.

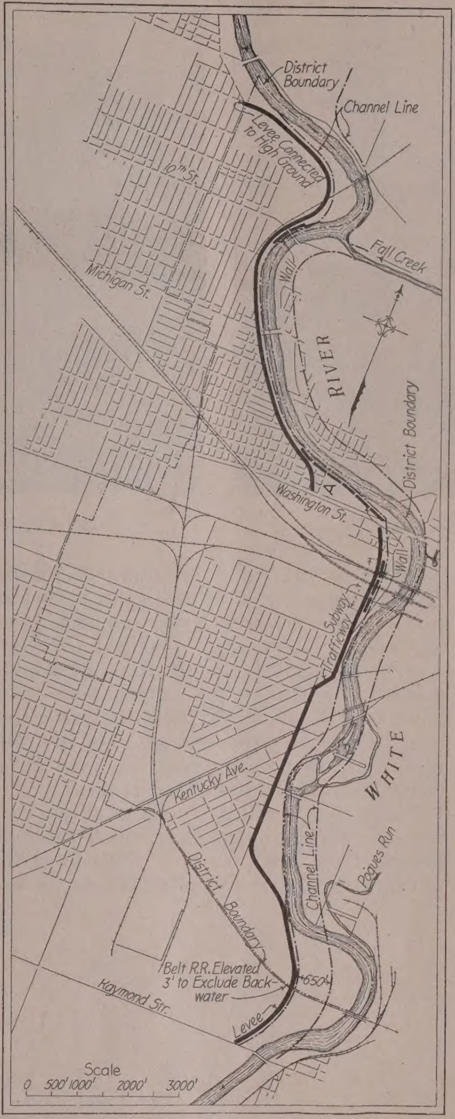
The Marsch-Cleary-White Company is doing all the work south of Washington Street, including the masonry retaining walls and excavation for the depressed roadway under the railroads at Kingan & Company's plant.

The fill from Washington Street to Morris Street, about 100,000 cu. yd., is being made from the widening at the bend south of Washington Street (see drawing) and that below Morris Street is obtained from the borrow pit in the channel change at the extreme south end of the work. Here a Monigan No. 2 dragline handling a 1½-yd. bucket is throwing dirt from the borrow pit directly into that part of the levee which lies adjacent to it. About one-fourth of the Kingan plant west of the river lay within the channel lines and had to be wrecked and moved to the west of the flood walls and levee. All streets intersecting the levee had to be raised and the dwellings fronting these streets have been raised to the new grades, and the lots are being filled to the new elevations under this contract. This work affects some ninety-five resident properties adjoining the levee but not condemned.

Hickey Brothers of St. Louis are subcontractors for building the 950 ft. of 40-ft. wall opposite Fall Creek by methods similar to those to be described below.

WALL AT WASHINGTON STREET

In the 260,000-yd. wall at Washington Street noted in the opening paragraph the methods used by the contractor, the Kuert Contracting Company of Indianapolis are as follows: The A-frame derricks are mounted on a platform straddling the completed sub-base and their booms are long enough to command the whole of the 40-ft. section opened. Three-inch oak sheeting is driven by a Vulcan steam hammer and braced with three sets of 10 x 10-in. wales and 12 x 12-in. cross-braces, one at each end and one at the center, thus giving plenty of room for excavating with the 1-yd. Hayward grab bucket.



WEST SIDE WHITE RIVER FLOOD PROTECTION AT INDIANAPOLIS

Portion of plant moved from point A back of levee.

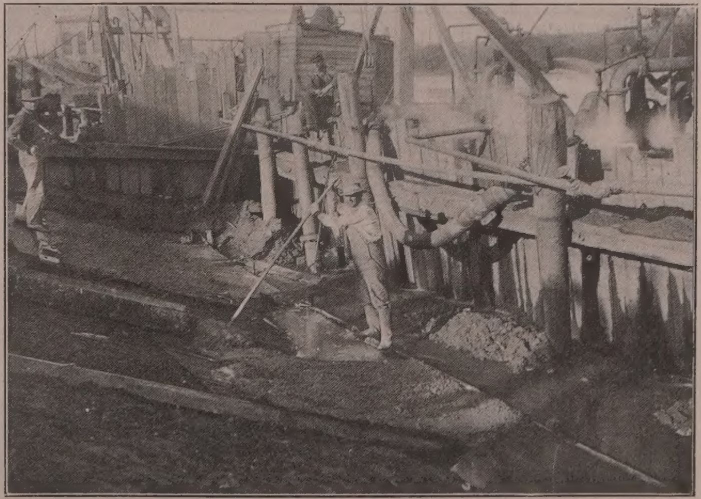
On account of the large amount of water a 10-in. Potts centrifugal pump, belt driven from a straight line Atlas engine, is started shortly after the excavation is begun. The discharge is through old sewers or new ones built through the bank to the river. The piles are imbedded in 18 in. of concrete and the spacing is such as to put only 2½ tons pressure on each one. Their principal function is to furnish stability should erosion ever endanger the foundations.

The material as excavated contains an excess of fine sand, otherwise it is considered proper for concrete and is delivered by bucket through a screen into a hopper feeding directly into a mixer placed high enough to discharge by chute into the trench. The mixture obtained is about 1:2 ½:5.

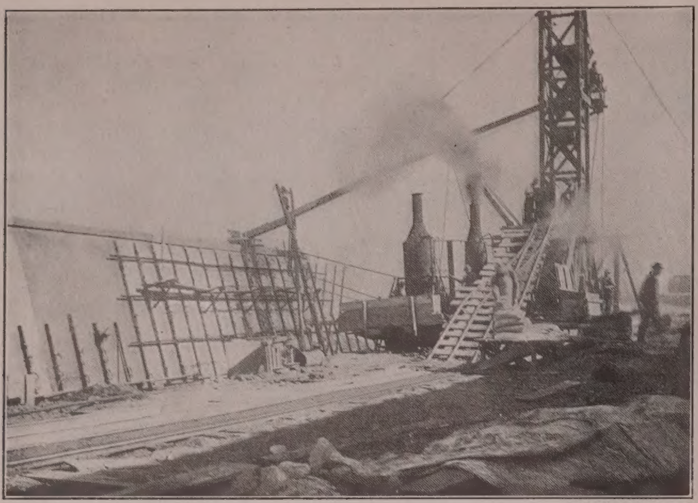
FILL STEEL FORMS RAPIDLY

For the high wall Hydraulic pressed steel forms are used in sections 26 ft. 8 in. long. As the total height of from 28 to 31 ft. is usually poured in 5½ hr., some interesting developments in the way of horizontal pressures have developed. When first set up the forms tended to tip toward the river, the side with the least batter. To overcome this ⅝-in. cables were attached to a deadman to prevent an additional thrust expected in the same direction during the deposition of concrete. Contrary to expectations the first forms filled started to move toward the bank. For a week speculation was rife among the engineers and contractors. Finally it was noted that the eight rods for each set of ribs tying the two sides together were not all exactly horizontal, on account of the fact that the holes punched in the ribs for them were all equally spaced, the side with the least batter gaining elevation the faster. It was therefore concluded that the uplifting component on the bank side was practically all cared for at the base, but that the slight horizontal component toward the bank due to the wet concrete at the top, which was transferred by the rods to a higher point on the forms on the river side permitted a movement toward the shore. Thereafter three ⅝-in. cables were placed on the river side to anchor each section during the period of concreting.

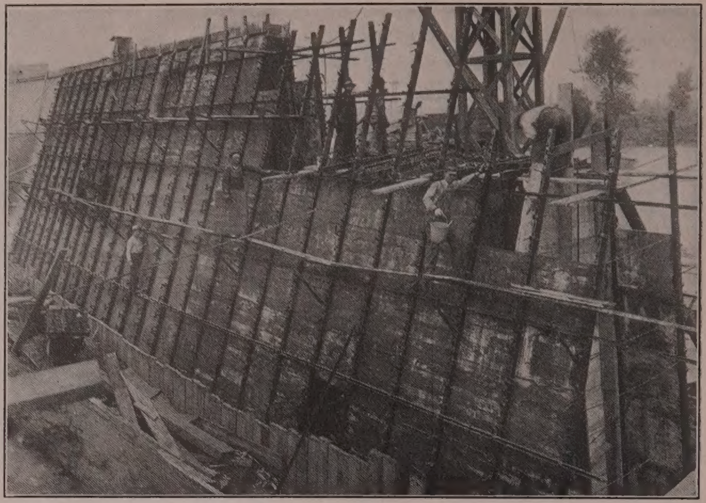
STIFFLEG FEEDS GRAVEL TO MIXER THROUGH SCREEN



TAR PAPER STRIPS OVERLAPPED TO EXCLUDE GROUND WATER



MATERIAL CARS COAST TO FOOT OF INCLINE



BRINGING AHEAD SMALL FORM PLATES FOR WALL

In carrying on this work the following régime is usually in force: To-day concrete is poured in a section. To-morrow morning the plates, of which there are sufficient for 1½ sections, are removed, carried ahead and placed on ribs erected the previous day. The ribs, of which there are enough for three sections, on concrete poured yesterday, are left until the second day before removing and re-erecting. The rods, which are held by Universal form clamps, are removed by a Universal puller and used again after passing through a small field straightener. The mixer is moved forward and a new material track laid on the day following concrete deposition. Every other day concrete is poured.

Six timbers hold the wood bulkheads in place. Two at the bottom are braced from 4 x 4-ft. upward keys left in the concrete base. The remainder are held by ¾-in. rods run through at least five vertical form ribs.

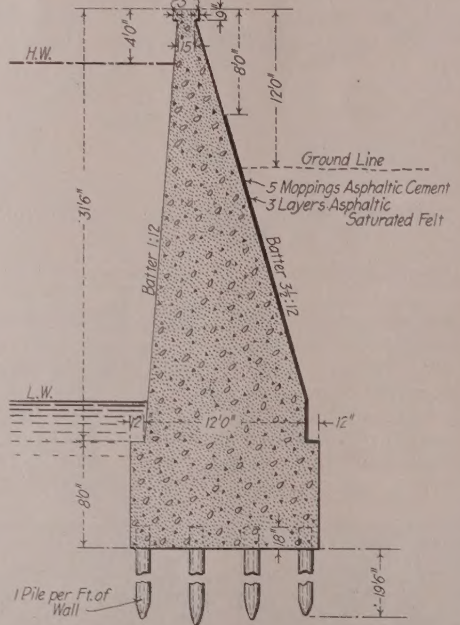
Use Aggregate Direct from River

The concrete plant, consisting of a ½-yd. Smith mixer and Insley tower, is mounted on a movable platform with a raised platform 15 ft. above the mixer platform, to which aggregate cars are hauled up an incline by means of a single drum hoist operated from the mixer engine. These cars are loaded some distance back on the bank of the river by a clamshell which digs the material from the river bed as needed and discharges it over a screen, whence it flows to a hopper feeding the cars. These cars are of a home-made bottom dump type holding ¾ cu. yd. From the bin the cars coast 100 ft. to the foot of a 20-ft. incline and are pulled up this incline by a hoisting engine and coast to the foot of the mixer platform, where cement is added. Double tracks are laid between the temporary pit and the mixer. Sixteen men plus an engineer and foreman form the crew in pouring the 200 cu. yd. in each section of form.

Riprap Laid on Paper "Shingles"

The Marsch-Cleary-White Company, general contractors, are carrying on the remainder of the work, including 95,000 sq. yd. of riprapping of all the earth levee sections. This involves laying up and down the slope a 15-ft. strip of 1:2:4 concrete, 4 in. thick, reinforced with No. 27 Triangle mesh. The toe of the paving ends at a point 6 to 10 ft. below the river low-water line. Concrete prepared in a ¼-yd. Milwaukee mixer on the top of the levee is led down the slope in open steel chutes.

To prevent washing out the green concrete by the ground water, which seeps in rapidly from the bank side, the contractor is using successive layers of tar paper laid like shingles, only in the reverse order; i.e., the top one is placed first with a lap of 4 in. This tends to lead the ground water down the slope to a point below the toe of the riprap, where it is easily pumped out. The excavation around the toe of this slope paving is protected on the river side by 15-ft. Lackawanna steel sheet piles driven by a 2000-lb. drop hammer into the gravel to a depth of about 10 ft. below the surface. Trenches 60 ft. long are dewatered at one time and are allowed to fill immediately after all the slabs have been placed.



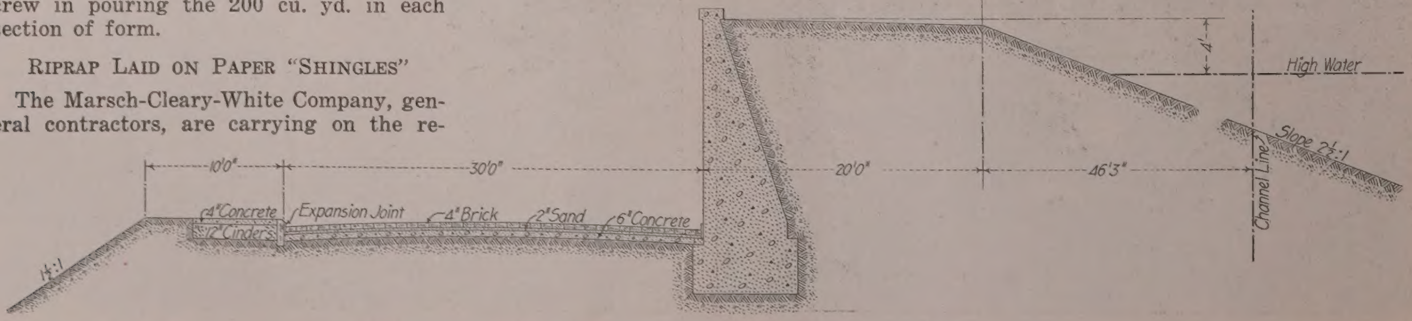
GRAVITY WALL, 2300 FEET LONG, OBVIATES MOVING CAR BARNS AND POWER STATION

The flood protection work is being carried out under the direction of B. J. T. Jeup, city engineer, with D. C. Hayne, assistant city engineer, directly in charge of the design and construction. H. B. Mitchell is resident engineer for the Marsch-Cleary-White Construction Company. P. E. Hickey, of Hickey Brothers, Thomas Kearns, of T. A. Kearns Company, and John Kuert of the Kuert Contracting Company are personally in charge of their respective sub-contracts.

New Orleans Record for Succession of Storms Broken

Over 19 Inches of Rainfall in 15 Days—Drainage System Temporarily Crippled by Hurricane of September 29

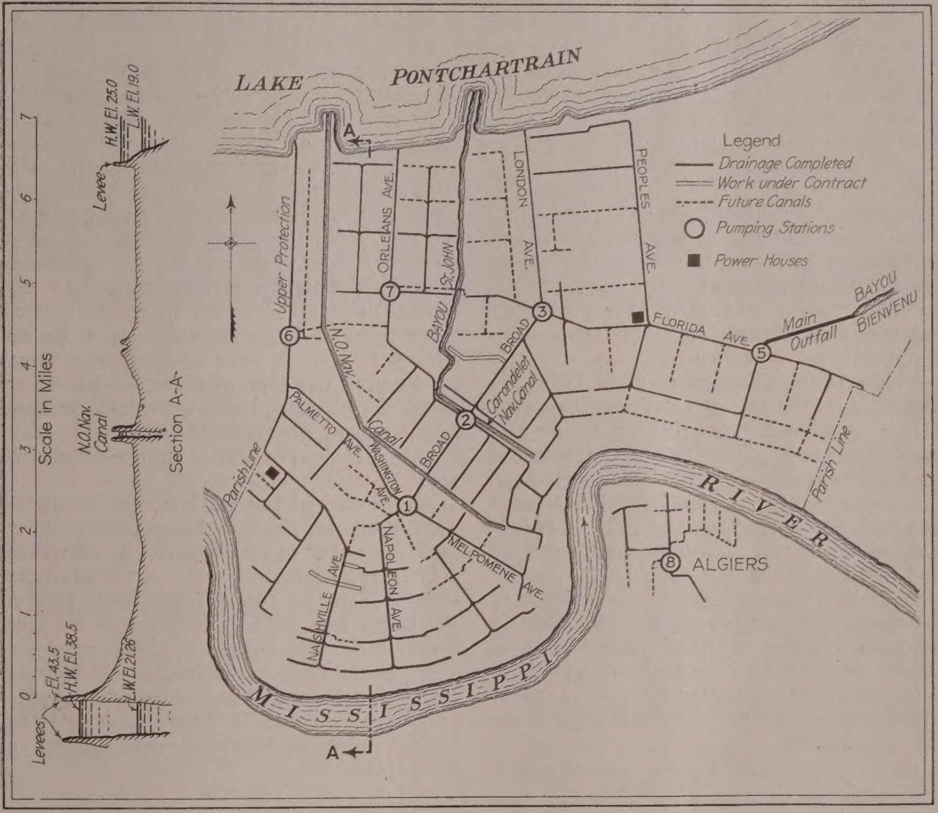
NEW ORLEANS has just been through an extraordinary experience due to a rapid succession of heavy storms, the first accompanying the hurricane of Sept. 29, which left hardly a single roof in the city undamaged. Heavy rains are a matter of greater concern to New Orleans than to other cities, because a goodly portion of the city is at or below the level of Lake Pontchartrain, bounding the city on the north, and a still larger area is below the



ROADWAY ALONG LEVEE IS CONTINUED IN SUBWAY UNDER RAILROADS mean level of the Mississippi River, forming the southern boundary of the city. Consequently, all of the storm water, as well as the sewage, must be pumped. The hurricane crippled the transmission system between the power and the pumping stations during the first storm, delaying the handling of the storm water, but the subsequent storms, unaccompanied by destructive winds, were handled with little or no difficulty. A detailed account of the experience of the system has been prepared by George G. Earl, general superintendent of the Sewage and Water Board of New Orleans, as a report to the board and certain facts therefrom are here presented.

RECORD OF THREE STORMS

From the records of the board prior to Sept. 29, this year, it would appear that a rainfall of 7 in. or over in 24 hr. was to be expected on an average of about once in 11 years, and that the average year would show a maximum rainfall in 24 hr. of about 4½ in. Six recording gages have been maintained by the board, or its predecessor, the Drainage Commission, since 1894. Prior to the recent storms there were only two which recorded as much as 7 in. in 24 hr. on any of these gages. One of these, in 1903, recorded 9.21 in. in 15½ hr., and the other, in 1907, showed 8.12 in. in 26 hr. Nevertheless, in the period from Sept. 29 to Oct. 13, inclusive, this year, there were two storms which recorded over 7 in. in 24 hr., and between them was a storm which exceeded the maximum storm of many of the years in this period.



SINCE GROUND LEVEL OF NEW ORLEANS IS BELOW RIVER ALL DRAINAGE AND SEWAGE MUST BE PUMPED

Present pumping capacity can handle 3½-in. rainfall on area of 25,000 acres in 24 hours. Dry weather flow is normally pumped through stations 1, 2, 3 and 5 to Bayou Bienvenu and thence to Lake Borne. In heavy storms, when dilution is great, stations deliver to Lake Pontchartrain.

Specifically, the storm of Sept. 29, 1915, gave a maximum record of 8.36 in. in 21 hr.; that of Oct. 12-13 showed 7.96 in. in 21¾ hr., while in between, on Oct. 3, 4, 5 and 6, 5.92 in. fell in 60 hr., making a total for the 15-day period of 22.24 in. These are maximum recorded falls. The average record of all the six gages maintained by the board for the period was 19.24 in., while the record of the United States Weather Bureau office at New Orleans was 19.91 in. for the same period.

Compared with this record it is interesting to note that the heaviest recorded rainfall for any previous consecutive period of 15 days was in April and May, 1907, when the gages showed 14.1 in. Moreover for any one calendar month previously the maximum was 16.1 in., recorded in September, 1898.

If the above described rainfall had been spread uniformly over the 15-day period, it would have amounted to 1⅓ in. per day and would have given the city drainage system no trouble at all, because the present capacity of pumps discharging into the various high level outfall canals is sufficient to discharge into said canals each day as much water as a 3½-in. rainfall precipitates upon the 25,000 acres of drained area of the city. When the additional pumps now under contract are installed the discharge capacity will be equal to all of the precipitation which a 7⅓-in. rainfall in 24 hr. can pour upon the same area.

HURRICANE OF SEPTEMBER 29

The hurricane of Sept. 29 began on the night of Sept. 28 with rain and a gradually increasing northeast wind. By 7 o'clock on the morning of the 29th the wind had reached a velocity of 40 miles an hour and increased gradually until the maximum steady blow of 80 miles was reached between 5 and 5.30 in the afternoon. At 7 o'clock that morning the drainage system was operating normally. The first indication of trouble was at 10.50 a. m. when heavy short-circuits occurred. These continued with increasing frequency during the day until at 5 o'clock in the evening, when the storm was at its height, the short-circuiting and destruction of transmission lines caused the shutting down of the pumping stations. When final shutdown came the water on the suction side of the stations stood at various levels from 19.2 to 22.0 C.D., indicating the flooding of large portions of the city, since much of it is at elevation 20. While linemen were kept on duty all night, little could be done until Thursday morning. By extraordinary efforts, Station 3 was put in operation by noon and Stations 6 and 7 by 7 o'clock of the evening of Sept. 30. At 8.40 on Oct. 1 Station 7 was in operation and the remainder were thrown into service shortly thereafter.

Drainage water to be handled, however, came not only from the rainfall but from the lake, the levees being overtopped by several inches at several places. For this reason Mr. Earl joins with the chief engineer of the Orleans Levee Board in urging that the levees be raised in order to protect the city beyond question from lake tides. The Sewage and Water Board is constructing its own outfall pumping stations with a view to being able to maintain them in operation with a maximum water elevation of 30 C.D. on the discharge side. The maximum attained in this storm was 26.2.

By Friday night the area between the two navigation canals was practically free of water, and by Saturday night, Oct. 2, most of the water had been removed from the large low area above the New Basin Navigation Canal and back of Clara Street. A portion of the city, however, which is very sparsely settled, was not relieved of water until Wednesday, Oct. 6, despite the fact that the pumping stations were operated continuously from the afternoon of the day following the storm. This was due to the crevasses and overtopping of the levees.

REMEDIES PROPOSED FOR TRANSMISSION LINE TROUBLES

As a cure for the transmission line interruptions, it has been proposed that the lines be put underground. This proposal Mr. Earl considers and dismisses as being prohibitive from the standpoint of cost. Moreover, such systems are subject to trouble no less than overhead lines, particularly where heavy rainfalls, as is the case in New Orleans, completely saturate the ground. Stations operated independently by steam power have also been urged, but taking into consideration all of the facts, Mr. Earl believes the present system is more certain to give satisfactory results than any proposed.

Reviewing these storms, in conjunction with the fact that there was a sustained wind velocity of over 80 miles an hour, and velocities up to 120 and 130 miles in gusts, with a lake level of 26.2 C.D. (Cairo datum), whereas previous wind velocities have not exceeded 70 miles an hour and lake elevations have not been above 25.7, the report concludes that a repetition of these conditions in the near future is improbable. Mr. Earl, therefore, believes that the citizens of New Orleans ought to feel confident that they can proceed with the rapid development now in progress without any question as to the probability of properly handling the drainage.

Ten and Three-Quarters Miles of 36-Inch Riveted-Steel Pressure Line Built on Sooke Work

Efficient Workshop Fabricated Sections from the Plate for the Pipe Line of Victoria's New Water Supply System

By BOYD EHLE, M. Am. Soc. C. E.
Of the Sanderson & Porter Engineering Staff—Resident Engineer, Sooke Lake Water Supply System

THE NEW Sooke Lake water supply system for Victoria, B. C., has been described in a number of articles in the Engineering Record. In two articles by the writer, in the issues of Oct. 2, page 406, and Oct. 23, page 507, the general features of the system were described, some costs were stated and special attention was given to the method of building the 27-mile, 42-in. concrete flow line. The lower end of the line, as described in the first of the articles just referred to, is composed of riveted-steel pipe, $10\frac{3}{4}$ miles long, 36 in. in diameter, made from both 5/16-in. and $\frac{3}{8}$-in. plate. Of the total length of 56,677 ft. 20,137 are of the thinner and the remainder of the thicker plate. This article will be devoted to a description of the fabricating plant and of the construction of the steel line. Some data will also be given as to the cost of the work.

BEGINNING OF WORK

Only 2685 ft. of the $\frac{3}{8}$-in. pipe had been laid by the original contractors prior to closing their work. They had erected a shop at Thetis Cove, Esquimalt Harbor, and started to make pipe. About 3000 ft. in various stages of completion was worked on, none of which was accepted by the engineers. This pipe was later made over by the succeeding contractor at greater cost than using the plain plate. The plate came from Pittsburgh around South America in tramp steamers to Esquimalt Harbor and was lightered to the shop wharf, where it was unloaded by derrick onto tram cars and stored in a plate shed at the end of the shop.

Upon the failure of the original contractor, the city relet the fabrication and laying of the riveted pipe to the Burrard Engineering Company, Ltd., of Vancouver. This company was associated with Angus McDonald, an experienced pipe maker, who brought over his plant and trained organization from Barnet to the shops purchased from the receiver for the former contractor, and personally supervised the fabrication of the pipe with excellent results.

Trenching and backfilling the pipe was done by day labor under the engineer's supervision. The minimum depth of cover for the pipe was $1\frac{1}{2}$ ft., but in the streets and roads it was necessary to go deep enough through the hills to conform to the projected regrading. Jackhammer drills, using air from gasoline compressors, were used in the rock trenching.

PIPE

The plate for the pipe was of open-hearth flange steel and the rivets of open-hearth extra-soft steel, according to the standards of the American Society for Testing Materials. Pioneer mineral-rubber pipe coating was used at first and later Geneseo,—about 6 lb. per foot of pipe.

The 5/16-in. plates were 68 x $117\frac{3}{4}$ in. and 68 x $119\frac{3}{4}$ in.; the $\frac{3}{8}$-in. plates 68 x 118 in. and 68 x $120\frac{1}{2}$ in. for inside and outside courses. The pipe was fabricated in four courses—about 22 foot lengths—for straight pipe. The rivet holds were punched and then reamed to size. Longitudinal seams were lap-joint double-riveted and girth seams single-riveted.

Split calking was done inside and out at all seams with air hammers. The plate in all cases was tightly bolted up and the contractor used an air hammer on the longitudinal seams to lay up tight the edge of the plate. There were two templates for the 5/16 and for the $\frac{3}{8}$-in. straight pipe, and three special templates for each size plate to give $\frac{1}{2}$, 1 and $1\frac{1}{2}$-deg. cuts for the curve pipe. These special templates were prick punched on the plate, while the standard templates were clamped to the plate for punching. Filler pipe were cut to length at the shops and rushed out to the pipe laying as soon as the closure distance to the curve points could be closely measured.

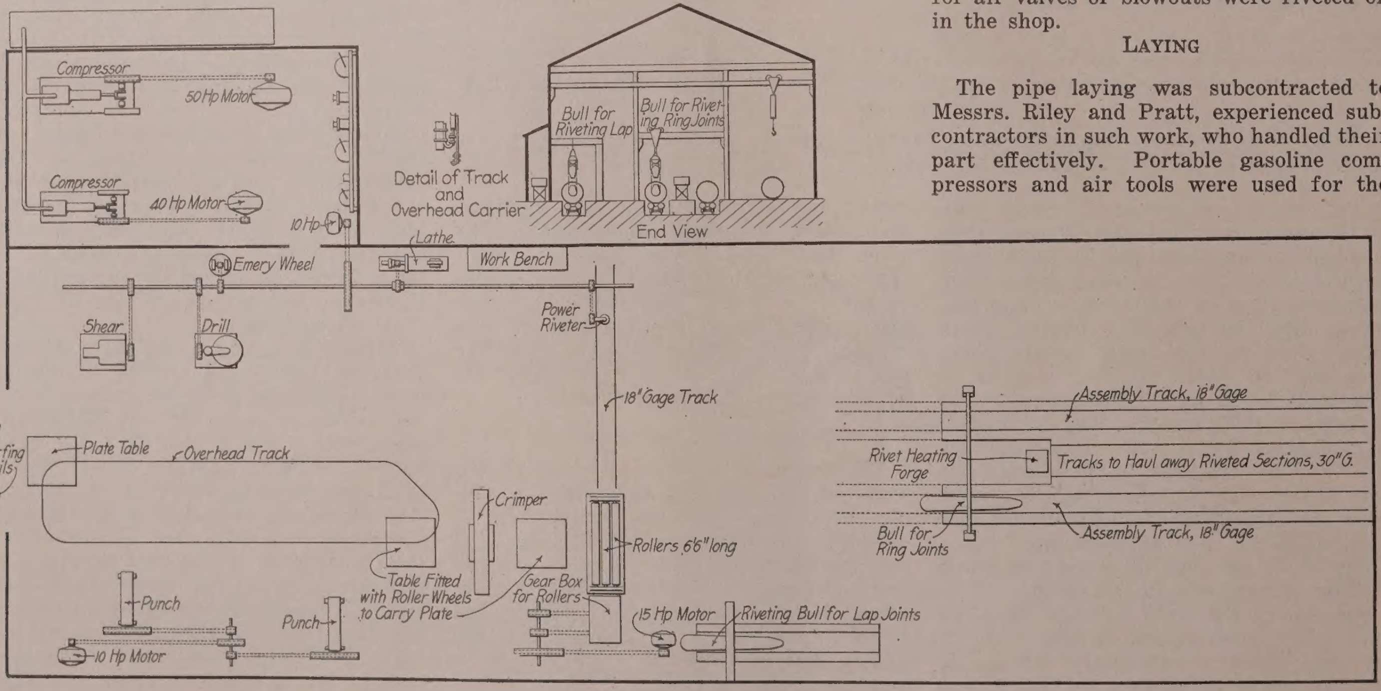
SHOP

Electric motor drive was used in the shop. Plate was taken from the storage piles on either side of a tram track by an overhead traveling crane with an air hoist, attached to a trolley on the lower flange of the crane girder, and loaded to a flat car for delivery to the shop. At the entrance of the shop, the plate passed to the scarfing anvils. It was then lifted and passed to the punches by an overhead hanging track, after the template was clamped to it. These punches were offset so that the nearer one worked on the narrow side of the plate and next on the wider without any shifting sidewise. From the punches the plate was sent directly ahead on rollers to the bending rolls. The rivet holes were reamed and the ring course sent to the first riveting bull, riveting the longitudinal seams. The edges of the longitudinal seam were hammered tight and the course passed ahead to the assembling bull, which was hung from an overhead trolley to serve two depressed assembling tracks. The pipe was hoisted by an air lift to a truck with a swivel mounting, for turning the pipe at right angles, after which it was pushed out to the calking shed at the end of the shop. The method of assembling the curve pipe is shown in a drawing.

At the end of the calking shed, the pipe was immersed in the horizontal dipping tank for about one-half hour. It was then hoisted to an inclined position for draining and rolled out on the storage trestle to dry. The pipe was loaded at the end of this trestle on trucks hauled by horses for delivery to the line. Each special was marked with the station number to insure delivery to the proper point. All nozzles and fittings for air valves or blowouts were riveted on in the shop.

LAYING

The pipe laying was subcontracted to Messrs. Riley and Pratt, experienced subcontractors in such work, who handled their part effectively. Portable gasoline compressors and air tools were used for the



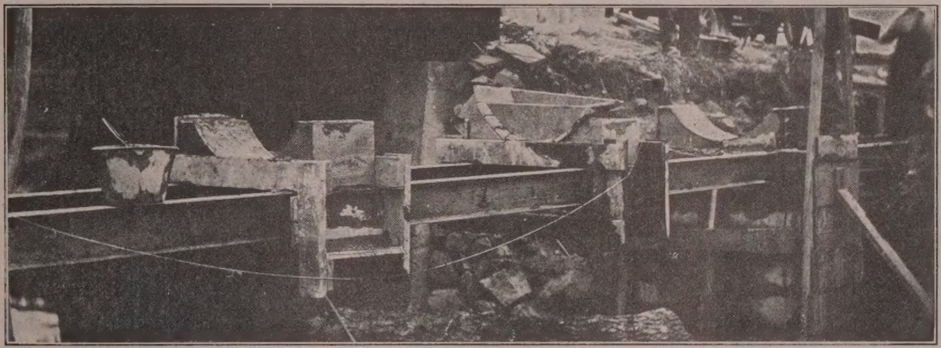
THE MAKING OF THE STEEL PIPE FOR THE PRESSURE LINE WAS HANDLED EFFICIENTLY IN THIS PLANT

TABLE 1—COST OF 36-INCH STEEL PRESSURE LINE 36,540 FT. OF ⅜-IN. PLATE; 20,137 FT. OF 5/16-IN. PLATE

(From engineers' cost accounts)

	⅜-In.	5/16-In.
Plate	$3.35	$2.74
Rivets	0.28	0.18
Hauling	0.205	0.165
Fabrication	0.668	0.668
Laying	0.366	0.366
Miscellaneous	0.407	0.407
	$5.276	$4.526

field riveting and calking. The pipe was rolled to the trench, and lifted and jointed by means of a tripod derrick having hand winch power. Rivets were driven from the inside, using a hammer "hold up" on the outside of the pipe held by a chain. Drop holes for delivering the rivets inside the pipe were cut with a field hand-punch and threaded for screw plugs. All bell hole excavation and unwatering was done by the city and the contractor was never delayed by such work.



CONCRETE SADDLES ON I-BEAMS CARRY STEEL PIPE ACROSS DRAWS

The costs are given in Table 1, while Table 2 gives the wage scale.

The work was done under the direction of C. H. Rust, Mem. Am. Soc. C. E., city engineer and water commissioner of Victoria, B. C. Wynn Meredith, Mem. Am. Soc. C. E., a member of the firm of Sanderson & Porter, New York and San Francisco, was consulting engineer, and the writer resident engineer.

TABLE 2—WAGE SCALE, RIVETED PIPE WORK

	Per 9 hr.
Foreman	$7.00
Layer out	5.00
Punchman	3.50
Punch helper	3.00
Scarfer	4.00
Rollman	3.50
Riveter	4.00
Rivet heater	3.25
Holder on and bolting up	3.00 to 3.50
Bucker up	3.00 to 3.50
Calker	4.50
Dipping tankman	3.00 to 3.50
Machinist	5.00
General helper	3.00
Rounder up	3.50
Watchman	3.00
Field Work	
Foreman	7.00
Bull gang foreman, $5.50 ; two at $3.25 ; two at $3.50	
Riveting gun man	4.75
Rivet heater	3.75
Calker	5.00
Bucker up	4.00
Compressor engineer	4.75

LAND BORINGS IN CHICAGO with a drilling machine cost $1.94 per foot for five holes aggregating 151 ft. The holes were made through brick paving, concrete slabs and frozen ground in February. In two cases wells from 6 to 13 ft. deep had to be dug to cut through lower concrete slabs and to remove boulders. One shallow boring of 56 ft. and six deep borings for bridge foundations, all three totaling 795 ft., cost $2.46 per foot.

Terminals the Need of Inland Water Transportation

Ford, Bacon & Davis in New Orleans Report Tell What Must Be Done to Revive Mississippi River Traffic

THE NECESSITY for radical improvements in inland water terminals in order to realize the possibilities of inland water transportation has been repeatedly emphasized by proponents of such transportation. It was one of the points made by Capt. John H. Bernhard in his extensive discussion, abstracted in the Engineering Record of Sept. 11, page 332. Ford, Bacon & Davis, engineers, in a section of their report to the Board of Commissioners of the Port of New Orleans on the New Orleans Ship Canal and Terminal, go into the subject in more detail, setting forth the essentials of all-efficient water terminals. They deplore the fact that while the Government improves waterways it does little to supply terminal facilities. They urge public ownership of the waterfronts, and better development of them. They hold that to bring back river navigation in the Mississippi Valley every port town, large and small, must build suitable terminal facilities. These notes are taken from the report.

CHEAP TRANSSHIPMENT IMPERATIVE

The realization of cheap transportation lies in the facilities for loading and unloading and the transshipping of freight from one carrier to another; the ability to transfer a commodity from a water carrier to a railroad, or vice versa, and the quick and cheap delivery of this commodity to the consignee. A study of this subject clears up the mystery supposed to surround the decline of the inland water transportation in the United States, especially that on the Mississippi River, as a more effective method of competition than the cutting of rates has been the refusal of the railroads to co-operate with water lines in the handling of freight. Inasmuch as a great proportion of traffic does not originate or find its destination immediately along the river banks, it is imperative that they should have the co-operation of the railroads. This the railroads have refused and the public has been slow to furnish by necessary legislation and by publicly owned terminals. At the terminals on the Mississippi system especially, there is a conspicuous lack of co-ordination between the railroads and water lines.

It is possible at several Lake Erie ports for a vessel to discharge 10,000 tons of iron ore into cars, load 10,000 tons of coal from cars and clear within twenty-four hours of its entrance. The cost of coaling a boat from Memphis, Tenn., under ordinary conditions equals the cost of loading coal at Conneaut, delivering this at Duluth, a distance of 889 miles, and unloading it. For moving this coal in port about 60 ft. there is a terminal charge approximately equal to the cost per ton of transporting the coal from Pittsburgh to Memphis, a distance of about 1200 miles. The neglect of harbor facilities renders necessary the large crew of the river packet, and enormously increases the current expenses and fixed charges per ton-mile of freight carried on account of the length of time the boat is delayed in port.

FEDERAL AID LACKING

The Federal Government constructs or improves waterways, deepening channels and building revetments and breakwaters, but does not, in general, supply terminal facilities. These are usually provided, if they are to be had at all, by various agencies or by State or local authorities. In the past the public has left this important development largely to the railroads and certain private interests, but a complete co-ordination of all means of transportation centering in a city cannot be had between a large number of such private interests.

The ideal plan for a modern port would undoubtedly be to stop all railroads at a certain line or zone outside the city and then turn the freight over to a publicly owned belt railroad for delivery to consignees or co-ordination with the other carriers for further shipment. Under this plan the belt line and all necessary warehouses and docking facilities would be publicly owned and operated on a basis of actual cost of service, giving shipper and carrier absolutely the same treatment. So ideal a system would save millions of dollars of duplication of service and plant —the most wasteful phase of the present-day commercial operations.

INDUSTRIAL TERMINALS

There is another and more important consideration for the public ownership of port facilities, and that is that such facilities are no longer desired simply for the transshipment of freight passing through a port, but are needed in the service of a manufacturing and industrial terminal as well. The former type of port is especially useful to a great section of the country served, while the latter means a direct and permanent gain to the city or community owning the port. Through the industrial type of terminal raw goods pass into the city to be manufactured, and the finished articles pass out. In its highest form such a terminal is really an industrial area fed by railroads at the rear and vessels on the waterfront.

Essentials of such industrial terminals are (1) cheap land for manufacturing and storage sites, (2) cheap rentals, (3) cheap power, (4) cheap food supplies, (5) satisfactory banking facilities, (6) street and industrial railroad services and connections, (7) satisfactory health conditions, (8) schools and churches, and (9) satisfactory labor market.

WHAT IS NEEDED

The harbor of New Orleans in general meets all the requirements of an industrial terminal and a river, rail and ocean port. New Orleans is only one, however, in a chain of river terminals from St. Paul and

Minneapolis on the Mississippi River, Pittsburgh on the Ohio River and Omaha on the Missouri River to the Gulf of Mexico. As a step in bringing back river navigation every port town, large and small, must build facilities to handle freight between water and rail so that the water-borne traffic can be delivered to the warehouse of the buyer or picked up at the factory the same as rail traffic. There should be developed certain river terminals 300 or 400 miles apart for the long hauls which the river is particularly adapted to make, and these should be publicly owned and operated, their equipment consisting of (1) floating and stationary wharves with unloading, loading and conveying machinery; (2) terminal industrial basins where required; (3) terminal railroad yards; (4) belt railroads; (5) spur railroads extending back from the wharf front at right angles to the river and longitudinal belt trackage—these spurs to be of such length as to connect with the main trunk-line railroad and in such position as to serve existing and proposed industries; (6) car-lighterage or car-ferry equipment for loading direct from car to barge simultaneously with the loading from wharves; (7) freight lighterage equipment consisting of small barges used in the collection of freight; (8) warehouses, elevators and storage yards; (9) manufacturing lofts; (10) drydocks, and (11) paved motor roadways behind the wharves and over the entire wharf front to supplement the belt-railroad service.

How Quantity Competition Can Be Eliminated

H. M. Saumenig Tells Engineers of Chicago Association of Commerce About Americanization of English Quantity Methods

LITTLE DOUBT exists in the minds of many contractors that our present method of duplicating quantities by each contractor in preparing estimates on competitive building work is so wasteful that it will have to be revised at no distant time, according to H. M. Saumenig, who presented recently his solution before the engineers' division of the Chicago Association of Commerce. It is an Americanization of the English quantity methods. Mr. Saumenig would apportion the division of the work on a building between architect, quantity surveyor and contractor as follows:

The architect should prepare the plans and specifications, and the quality of the work contemplated should be absolutely determined by him. The quantity of work should be determined by a go-between —the quantity surveyor—whose function it should be accurately to prepare the quantities; to see that the architect's conception as to quality and quantity is correctly conveyed to the bidders; and to adjust, with the co-operation of the architect, any possible contradictions or obscurities in the plans and specifications which present-day speed and high-pressure methods make liable. Finally, the determining of unit prices and the execution of the actual construction should be by the general contractors and subcontractors under the architect's supervision.

The adoption of the English quantity system in its entirety, stated Mr. Saumenig, under which the owner pays direct for the cost of the quantities, is impractical in this country, for the present at least. You can all picture to yourselves the wail of anguish which the average owner would give if it were even suggested to him that we have quantities prepared on, say, an office building to cost $1,000,000, the quantities for which might cost at least 1½ per cent.

Deal with Contractor

The only manner, in Mr. Saumenig's opinion, in which the quantity system can be inaugurated here is by dealing directly with the subcontractors. This plan would involve the least number of difficulties, as the subcontractor now pays for the cost of the quantities any way, either in preparing them himself, personally, or by employing one or more estimators. Where he does it himself he is taking time away from the direct supervision of work actually in construction, and slighting generally other features of his business which are of equal importance. Where he employs estimators their salaries represent very tangible and substantial overhead. Representative concerns engaged in building construction are quick to realize that such a system as that proposed would ultimately tend to reduce this overhead, stabilize their profits, curb wildcat bidding and unreasonable competition, enable them to bid on more work at less cost, and eliminate losses due to errors in quantities.

Competition in prices is legitimate. Competition in quantities—our present system—is absurd and never can and never will, in any way, change the fact that a certain definitely fixed quantity of labor and material is necessary to complete any contract. There can be no legitimate competition in taking off quantities, except that unfortunate kind which bidders make for themselves when they take off too much or too little.

Any credit man or surety company would vouch for the statement that subcontractors generally are considered among the worst credit risks. The percentage of failures are due not so much to mismanagement as to incorrect estimating. Of the failures due to mismanagement most of these can be directly traced to the excessive amount of time spent in preparing quantities and the consequent neglect of supervision of actual work in progress.

The Owner Pays

It is entirely obvious that, in the long run, the economic debt which is being rolled up by present wasteful estimating methods is inevitably paid by the ultimate consumer, the owner. General losses in any one line of business endeavor cannot fail to affect the final selling prices in that particular trade. These losses in building construction represent the gross of all the quantities left out of all sub-bids, plus the bad debts of material men, plus general contractors' and subcontractors' failures. A great proportion of all these wastes is directly traceable to faulty quantities and needless duplication of estimating.

An owner only deceives himself when he believes that he is getting something for nothing. No amount of inspection or bonding will make a cheap building good or induce a subcontractor, who is endeavoring to save money at the expense of the job, to put in all that is called for.

The adoption of the quantity system would reduce the cost of building construction in three ways: First, a large part of the present excessive and unproductive overhead expense caused by wasteful estimating methods would certainly be saved; second, the subcontractors, who now spend much of their time in preparing quantities, would be more free to devote themselves to effecting economies in the conduct of their building operations and the actual supervision of construction; third, the system would obviate the necessity of adding to bids a sum for contingencies in order to cover possible errors in estimating. Mr. Saumenig is of the opinion that a very good definition of the word "contingencies," as used by subcontractors generally in their estimates, would be "Cost of estimating the jobs I didn't get."

Eliminate "Guesstimating"

When real estimating shall have superseded "guesstimating" general contractors and subcontractors as a body will have made a substantial step forward toward stable and legitimate profits, the architect will have obtained a better finished job that will more nearly represent his original conception, and the owner will have received what he paid for.

It is unfortunate indeed that the building industry, handling as it does such a large proportion of the output of the steel, glass, paint, lumber and slate trades, and practically all of the output of the cement, burnt-clay and cut-stone trades, should be thus handicapped. On the authority of a number of the surety companies, who are at present underwriting contractors' bonds, it may be stated that the successful inauguration of such a system as the one under discussion could not fail to stabilize the building business generally, and should tend largely to reduce the item which bidders now feel called upon to add in order to cover contingencies.

The objection may be advanced by some subcontractors that their smaller and perhaps less capable competitors, under such circumstances, would be placed, as far as the quantities are concerned, on the same basis as themselves. This is true. It is also true, however, that no subcontractor ever made money by under-estimating his quantities, and the contracts that responsible subcontractors now lose, other things being equal, usually go to some one who has left out something. This could not occur under the quantity system. We hear of many instances, these days, of work being let for less than cost. What is the result? The sub-bidders, whose quantities were assumably correct, are stigmatized as highwaymen and robbers, and the job is completed, perhaps, by the surety company which furnished the bond. As a possible consequence there is a new bankrupt added to the already long list. This situation does not help the responsible bidder who rightfully deserved the contract and who would probably have secured it had it not been for his competitor's errors in quantities.

Mr. Saumenig is of the opinion that the majority of financially responsible and competent general contractors and subcontractors in Chicago would much rather see more competition, with all bidders figuring on the same quantities, than to be "up against" the haphazard methods now in vogue, where the successful bidder is frequently the one who has succeeded in leaving out the most items.

Japan's Railway Mileage amounted to 5944 miles on March 31, according to a recent consular report. There was a gain of 265 miles during the fiscal year 1914-15.

Wire Cables of Various Types and Materials Tested by U. S. Bureau of Standards

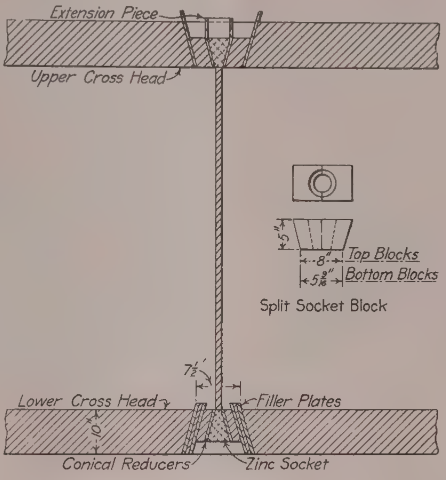
Methods of Preparing Specimens for Test Described—Results of Different Groups Show Wide Variations of Strength

TESTS of wire cables in three extensive series have been completed by the U. S. Bureau of Standards in a practical investigation carried on mainly for the Isthmian Canal Commission. The following description of the preparation of the test specimens and tables giving the results of tensile tests of 165 cables in series 3, ranging in diameter from ¼ in. to 1½ in., is taken from data furnished by the bureau.

PREPARATION OF SPECIMENS

In making a tensile test it is essential to insure unity of action of the strands and component wires, that the cable be free from bends, that the pulling force be truly axial and that the strands and wire be firmly held at the ends. A number of grips and end sockets have been devised to attain as high an efficiency for the combined strength of the individual wires as practicable and the simultaneous rupture of as many of the strands as possible. The length of specimen is important, many engineers advising 25 ft. or longer, but practical considerations fixed the length of specimens used at about 6 ft. 6 in.

Zinc sockets were used throughout in making the tests. The cables were prepared for making these sockets by first wrapping lightly for an inch or two with soft wire, both at the ends and at points varying from 5½ to 9 in. or more from the ends according to the length of the socket. After winding, the cable was inserted in the molds, the ends were unraveled, the rope core was removed and the separate wires were wiped clean with waste and gasoline. In the larger sizes unusual care is required in the cleaning, as even a slight amount of grease or rope lubricant causes slipping at high stresses. The cable may be dipped in a strong solution of caustic soda, or for a few minutes in a solution of hydrochloric acid.



SOCKET BLOCKS AND INSERTION IN TESTING MACHINE

Split socket blocks of drop forged steel with finished surfaces are held by filler plates. Conical reducers used for smaller cables, and extension pieces for the longer sockets on the 1¼-in. and 1½-in. cables.

Commercial spelter melted to a temperature of 400 to 500 deg. C, is then poured around these wires in the mold or socket, which is held in a vertical frame that keeps the cable concentric with the axis. These sockets fit into wedge-shaped recesses in the machine heads, as shown in the accompanying drawing. In the tests of the ¼-in. cables more than 50 per cent failed at or near the sockets. In the majority of cases this was due to the overheating of the small wires, and care should be taken to have the spelter no warmer than is necessary. A number of experiments showed that better breaks can be obtained for small-diameter ropes by simply unwinding the strands and bending each strand back upon itself without further bushing.

DESCRIPTION OF SPECIMENS—RESULTS OF TESTS

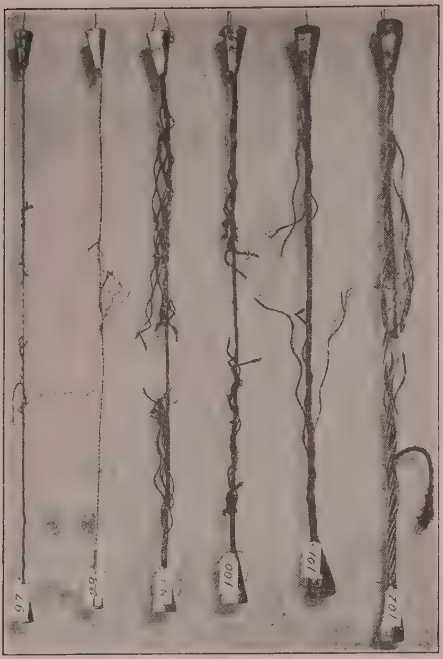
The 165 cables, for which results are here given, varied in diameter from ¼ in. to 1½ in., and in nature of construction from the more usual six-strand, nineteen-wire type to the eight-strand, nineteen and six-wire type. The results for tensile strength are averaged in groups in Table 1. The original tables include the reduction in diameter and percentage of elongation under loads below the ultimate, but space limitations preclude their inclusion here. The average lay and average size of the hemp core for the various sizes of cable are as follows:

Size of cable, in.	Lay, in.	Hemp core, in.
¼	2	⅛
⅜	2¾	⅛
½	3¾	3/16
⅝	4½	¼ to ⅜
¾	5½	⅜
⅞	6½	7/16
1	6 to 8	½
1⅛	7¼ to 9	⅝
1¼	7 to 10	⅝
1½	11 to 12½	¾

The tests of individual wires for some of the ⅝-in., 1¼-in. and 1½-in. cables have been averaged and are given in Table 2,

TABLE 1—RESULTS OF TEST OF WIRE ROPES AND CABLES

Description	Number tested	Total load, lb.			Net section, average, sq. in.	Unit stress, lb. per sq. in.			Strands and wire
		Min.	Aver.	Max.		Min.	Aver.	Max.	
Twelve ¼-Inch Wire Ropes									
Swedish iron	1	....	2,920	....	0.017	....	167,800	....	6-19
Tiller ropes	3	2,238	2,340	2,440	0.017	130,700	141,000	152,500	6-42
Crucible cast steel	8	4,200	4,800	5,610	0.024	183,400	198,200	216,000	6-19
Eleven ⅜-Inch Wire Ropes									
Swedish iron	1	....	4,585	....	0.060	....	75,900	....	6-19
Tiller ropes	1	....	4,460	....	0.039	....	115,000	....	6-42
Crucible cast steel	2	10,270	10,300	10,320	0.0565	182,000	182,200	182,400	6-19
Galvanized steel	7	3,780	3,940	4,020	0.054	70,500	73,000	76,400	6-7
Eleven ½-Inch Wire Ropes									
Crucible cast steel	3	16,280	17,840	18,960	0.103	157,300	175,600	195,300	6-19
Galvanized steel	3	6,930	7,620	8,000	0.093	77,700	82,000	89,700	6-7
Tiller ropes	5	5,850	6,370	6,780	0.068	81,900	92,700	108,100	6-42
Ten ⅝-Inch Cables									
Galvanized steel	2	12,950	13,190	13,430	0.162	80,700	81,600	82,500	6-7
Galvanized plow steel	1	....	32,920	....	0.159	....	207,000	....	6-19
Crucible cast steel	3	26,220	26,750	27,170	0.153	169,000	175,400	186,100	6-19
Extra flexible steel	4	24,980	28,060	30,900	Varies	126,700	198,200	249,700	8-19
Eleven ⅝-Inch Cables									
Galvanized plow steel	3	30,480	34,500	36,700	0.148	212,900	232,100	243,100	6-19
Plow steel	1	....	31,200	....	0.1505	....	207,300	....	6-19
Crucible cast steel	3	26,830	27,750	29,150	0.164	162,800	169,200	179,300	6-19
No record	4	28,410	30,670	33,510	0.149	183,500	206,500	233,800	6-19
Eleven ⅝-Inch Cables									
Special hoisting	4	32,250	33,870	35,990	0.157	192,300	217,200	245,000	6-19-6
Extra flexible	4	29,710	30,200	30,680	0.145	203,500	208,400	221,600	8-19
No record	3	29,940	32,400	34,000	0.148	196,900	205,500	210,600	6-19
Eleven ⅝-Inch Cables									
Plow steel	1	....	33,970	....	0.143	....	237,100	....	6-19
Galvanized steel guy rope	1	....	12,426	....	0.162	....	76,900	....	6-7
Extra flexible	2	24,660	24,980	25,300	0.122	198,900	204,100	209,400	8-19
Crucible cast steel	2	30,930	31,480	32,020	0.165	187,400	190,700	194,000	6-19-6
No record	5	30,350	31,510	32,280	0.158	192,200	199,600	204,400	6-19
Eleven ⅝-Inch Cables									
Flat strands	5	34,220	35,540	36,610	0.187	183,300	190,400	196,100	6-25
Plow-steel "digging" rope	1	....	30,200	....	0.159	....	189,700	....	6-19
"Digging" rope	2	30,200	30,730	31,260	0.140	210,500	220,800	231,100	....
Hoisting rope	3	25,890	28,380	29,700	0.139	188,400	204,900	227,200	....
Nine ¾-Inch Cables									
Galvanized steel	1	....	14,190	....	0.1905	....	74,500	....	6-7
Plow steel	1	....	48,030	....	0.235	....	204,400	....	8-19
No record	3	43,500	47,240	49,780	0.214	199,400	221,100	232,900	....
Crucible cast steel	4	36,610	39,210	44,020	0.223	171,900	175,800	179,500	6-19
Twelve ¾-Inch Cables									
Extra flexible	4	36,900	38,930	42,730	0.198	180,300	196,800	216,500	8-19
Tiller rope	1	....	42,050	....	0.207	....	202,900	....	6-19
Special steel	1	....	46,210	....	0.218	....	212,400	....	6-19-6
No record	2	40,260	43,040	45,820	0.216	178,000	199,600	222,100	6-19
Crucible cast steel	4	41,680	42,300	43,040	0.240	173,700	176,600	179,300	6-19-6
Eleven ¾-Inch Cables									
Plow steel	1	....	52,620	....	0.233	....	225,900	....	6-19
Crucible cast steel	2	40,560	41,500	42,450	0.235	172,500	176,500	180,600	6-19-6
Special hoisting	2	33,290	39,970	46,640	0.203	195,400	197,000	198,500	6-19-6
No record	2	44,210	45,330	46,440	0.225	200,600	202,000	203,400	6-19
Extra flexible	4	36,330	41,970	45,300	0.216	182,800	193,600	203,500	8-19-6
Ten ⅞-Inch Cables									
Crucible cast steel	6	48,150	51,620	56,000	0.288	175,100	179,400	186,700	6-19-6
Galvanized steel	1	....	22,410	....	....	....	84,900	....	6-7
Special	2	64,090	69,550	75,010	0.308	220,500	225,300	230,100	....
Extra flexible plow steel	1	....	52,560	....	0.256	....	205,100	....	8-19
Twelve 1-Inch Cables									
Plow steel	1	....	62,150	....	0.328	....	189,500	....	8-19
Tiller ropes	2	17,230	17,340	17,450	0.252	63,600	69,350	75,100	6-42
Galvanized steel	2	24,800	26,320	26,850	0.386	61,200	69,700	78,200	6-7
Crucible cast steel	3	66,640	69,050	70,750	0.383	179,100	180,300	182,900	6-19-6
Extra flexible	4	59,110	....	80,580	0.400	137,200	175,600	211,500	8-19
Nine 1⅛-Inch Cables									
Galvanized iron	2	34,010	34,210	34,410	0.500	65,800	68,500	71,200	6-7
Galvanized steel	2	36,650	44,500	52,350	0.479	79,700	92,300	104,900	6-7
Crucible cast steel	5	78,100	84,220	93,000	0.460	159,600	183,600	206,200	6-19-6
Seven 1¼-Inch Cables									
Extra flexible	1	....	112,950	....	0.905	....	124,800	....	8-19-6
Galvanized steel	2	117,700	120,750	123,800	0.595	182,500	204,450	226,400	6-37
Crucible cast steel	4	96,140	103,560	109,030	0.625	158,800	165,750	178,500	6-19-6
Seven 1½-Inch Cables									
Plow steel	1	....	163,770	....	0.856	....	191,300	....	8-19
Galvanized steel	1	....	154,550	....	0.844	....	183,100	....	6-37
Extra flexible	1	....	166,450	....	1 132	....	147,000	....	8-19-6
No record	1	....	211,700	....	0.980	....	216,000	....	6-19-6
Special steel	3	183,180	185,500	189,900	0.943	194,300	196,700	201,400	6-19-6



FRACTURES OF CABLES OF VARIOUS SIZES

together with the ratio of the average strength of the individual wires to the strength of the cable as a whole. For the ⅝-in. cables these ratios average 1.23, which is a somewhat lower average efficiency than the 85 per cent often assumed by engineers. The larger cables, however, are seen to have very much larger efficiency.

The above data has been furnished through the authorization of S. W. Stratton, director of the U. S. Bureau of Standards, by J. H. Griffith, associate engineer-physicist and J. G. Bragg, assistant physicist. A number of these tests were made, data compiled and computations carried out by N. DeW. Betts, W. C. Campbell, L. H. Losse and H. Kaplan, assistant engineers, and J. G. Bragg and T. H. Holmes, junior engineers in the Technologic Branch of the U. S. Geological Survey.

TABLE 2—RESULTS OF TESTS OF INDIVIDUAL WIRES

Description	Average strength, lb. per sq. in.	Average elongation, per cent in 80 cm.	Ratio to Average strength of rope
⅝-in. special digging rope......	253,100	2.0	1.20
⅝-in. hoisting rope..........	252,300	2.0	1.27
⅝-in. plow-steel digging rope..	245,600	4.5	1.29
⅝-in. digging rope...........	270,000	2.3	1.17
⅝-in. hoisting rope..........	272,500	2.4	1.20
1¼-in. plow-steel cable........	192,900	....	1.06
1½-in. plow-steel cable........	189,500	....	1.04

RED-CROSS ROAD REPAIR SIGNS are one of the "stunts" employed by Jasper County, Missouri, in its good-roads movement, stated J. P. Clarkson at the recent Northwestern Road Congress at Cedar Rapids, Iowa. On his inspection trips the foreman employed by the county for road maintenance and repair work carries a supply of these signs to which are attached two repair form sheets. When the foreman discovers a bad spot in the road he fills out on one sheet instructions to the repair man and keeps the other for the office file. He then tacks the red-cross notice with its instruction sheet up on the fence or tree nearest the part of road to be repaired. These signs serve a two-fold purpose; they show the repair men where work must be done and they tell the traveler that the county officials are aware of the road condition and are going to repair it.

United States Will Capitalize Its Scenery

Newly Adopted Policy of Opening Up Our National Parks in the West Should Bring the Country $50,000,000 Annually

THE ASSETS which this country holds latent in National parks are to be developed and utilized if plans now being considered at Washington are carried to completion. Among those who have really seen something of the National parks, it is generally admitted that if their attractions were more generally known and more readily accessible the custom of visiting them would become much more popular than at present. This belief has at last brought about action on the part of authorities at Washington; plans are being considered for opening up the parks on a large scale, and meanwhile construction is being begun in Yosemite Park on the first of the chain of improvements.

SWITZERLAND'S EXAMPLE

Those who urged action on the part of the United States Government pointed out that Swiss scenery has been so advertised that in 1913 it attracted tourist trade amounting to $250,000,000. In that same year the passenger-traffic department of one of the large railroads in this country estimated that the sum of $500,000,000 was annually spent abroad by American tourists.

American scenery is not inferior to that found in Europe, it is asserted, and with proper equipment, management and advertisement, our scenic attractions could turn a large part of the tourist tide from Europe to our Western States. The superintendent of National parks has estimated that an annual saving of at least $50,000,000 would accrue to the United States within a few years under a policy of development which would open up the parks and advertise them adequately.

In contrast to other countries our National parks have never been supported by appropriations calculated to adequately develop and maintain them. On the contrary, when the question of appropriations for this purpose has come up before Congress, the parks have been looked upon as a liability and treated almost as a necessary evil. The money allotted to them, advocates of the new policy affirm, has too often been in proportion to the influence of those who represented the district—or perhaps of those who represented the voting power of the district.

All this is attributed largely to the fact that in such reasonable requests for funds as have occasionally been made, there has been no explanation of the value that such expenditure adds to the country's resources, and no statement of what return on the investment is to be expected.

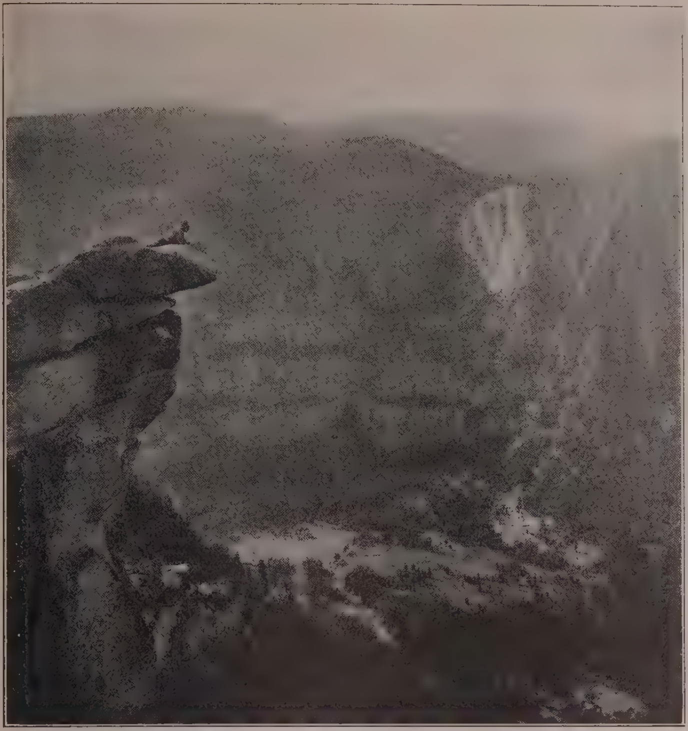
THE NEW POLICY

This situation is now entirely changed, and although no large appropriations are

NATIONAL PARKS OF THE UNITED STATES

Name	Location	Area, Sq. Miles	Roads and Trails	Hotel Accommodations
Sequoia Park.....................	California	2,525		
General Grant Park...............	California	40		Several hotels
Yosemite Park....................	California	1,124	75 miles roads 700 miles trails	For 3500 guests
Crater Lake Park.................	Oregon	159,360		
Mount Rainier Park...............	Washington	324	34 miles roads	Several hotels
Glacier Park.....................	Montana	1400		
Yellowstone Park.................	Wyoming	33,480	Sufficient roads and trails	72 hotels
Nesaverde Park...................	Colorado	640		
Hot Springs Park.................	Arkansas	14		Sufficient
Platt Park.......................	Oklahoma	47		
Wind Cave Park...................	South Dakota	312		

NEW ROAD UNFOLDS RUGGED SCENERY OF THE YOSEMITE


YOSEMITE VALLEY AS VIEWED FROM GLACIER POINT

LIBERTY CAP IN YOSEMITE NATIONAL PARK

immediately available for improvements, it can at least be said that officials at Washington are alive to the potentialities of the National parks as a feature in the development of the country. Plans for park development are being worked out on certain fundamental lines; there must be transportation facilities, suitable hotel accommodations inside the reservations, sufficient roads and trails to make the points of interest accessible, and, finally, these improvements must be exploited in a way that will attract tourist travel to them.

It has been shown that those who are allotted concessions in the parks for operating hotels and other tourist accommodations will neither make nor maintain suitable improvements on short-term leases. It was therefore decided that the best scheme is for the concessionaire to build chalets and hotels according to designs prepared under the superintendent of National parks, and then to operate these as concessions under long-term contracts.

Under the new scheme of leasing such concessions twenty-year permits will be granted and the permittees will pay the Government 50 per cent of their net revenues. At the end of the twenty years the buildings are to become the property of the Government. During the term of the lease the concessionaires are to keep their books open to inspectors, who are to see to it that the Government's proportion of profits is fairly represented. This plan insures the construction of only such buildings as will conform to the general scheme of development and will be adequate for the service it is desired to provide.

RELATION BETWEEN CONCESSIONAIRES AND GOVERNMENT OFFICIALS

A most important factor in managing hotel concessions is to be the relation between concessionaires and Government officials with whom they deal. It has been shown that difficulties of operation are certain to arise, and that if concessionaires find themselves in trouble the park officials can do far better by advising with them as to the best solution rather than by considering only the terms of the lease and leaving the lessee to make good in his own way or be ejected. It is planned to arrange the supervision in such a way that the benefits of experience in all of the reservations will be available to each concessionaire. It is thought that this will be greatly to the benefit of each, as well as for the permanent good of the parks.

As to the advertising campaign, it has been decided that the average tourist cannot be expected to read Government reports and bulletins on the geographical formation of the flora and fauna of any particular area, especially if these are in scientific language. To attract the public there must be announcements that in the National reservations are to be seen the deepest canyons in the world, the highest waterfalls, the greatest trees on earth and the oldest living thing known to man. The tourist must be told about transportation facilities, how long it will take to go, how much can be seen in a certain time and how much it will cost.

GOVERNMENT ROAD THROUGH TIMBER LAND OF RAINIER NATIONAL PARK

WORK NOW IN HAND

The general scheme for constructing a sufficient number of chalets in the several parks will be begun in Yosemite Valley in California. Here one large structure on the floor of the valley to cost $150,000 is just being undertaken, while a smaller hotel on Glacier Point will be begun next month. Other mountain inns throughout this reservation are then to be built at the rate of three per year until the chain of twenty-three is complete. About 75 miles of road are to be constructed to bring the park up to the standard of accessibility.

Glacier Park will require about forty-three inns and 60 miles of road, but actual construction will not be undertaken there until the plan as it is being carried out in California has progressed somewhat. A plan has been proposed for the enlargement of Sequoia National Park to take in Mount Whitney and the Kings River canyon. If this is carried through, forty-seven mountain inns will be required to equip that area adequately. Mount Rainier Park will require several inns and about 75 miles of road.

In handling the entire matter of inaugurating a radically new National-park policy the study of what can best be done and how to do it has devolved largely upon the office of general superintendent of National parks, recently created for this purpose by Mr. Lane, Secretary of the Interior. The first appointee to this position is Mark

Daniels, a civil engineer experienced in landscape and highway engineering, who has taken up headquarters in San Francisco and is working out detailed plans for extensions in addition to supervising the work already under way.

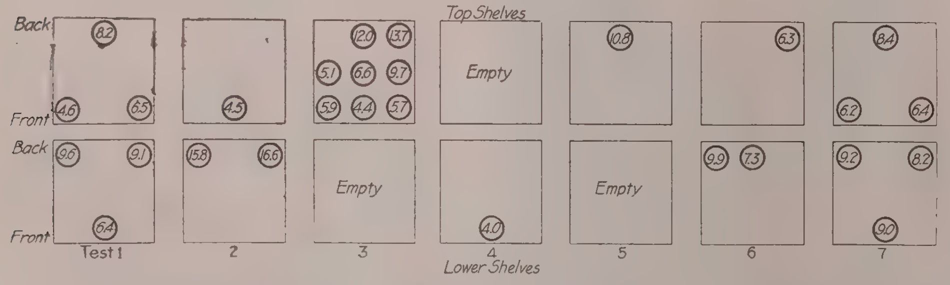
Road Oil Test for Loss on Heating Needs Revision

Wide Variations in Evaporation Due to Convection Currents in Heating Ovens Now Used

By NORMAN CHIVVIS
Chief Chemist, Municipal Testing Laboratory, St. Louis, Missouri

IN practically every specification for road oil appears a clause stating that the oil shall not show more than a certain percentage loss when heated a given period at a given temperature. Sometimes the amount of oil to be used is stated and the dimensions of the receptacle specified. The difficulty of obtaining consistent results in evaporation tests has led to the advancement of many methods of performing this test, none of which at the present time seems perfectly satisfactory. It is practically impossible to obtain concordant results in the same laboratory with the present methods. Naturally, results from various laboratories are very hard to compare.

One great difficulty, that of holding a constant temperature throughout the period of the experiment, has been practically eliminated by the introduction of the electric constant-temperature oven with thermostatic control. The Freas constant-temperature oven is one of the best known and is capable of holding a temperature constant to within a few degrees Centigrade for an indefinite period. The dimensions of the receptacle for the oil and the amount of oil used in the test affect greatly the result, as they determine not only the surface exposed to evaporation but also the accessibility of air to this surface. Oil in a very shallow vessel would obviously show a greater loss than the same oil in a relatively tall vessel of similar capacity. This is generally ascribed to the ease with which air currents may pass across the shallow vessel, thus accelerating evaporation.



LOSSES OF WEIGHT ON EVAPORATION VARIED GREATLY WITH POSITION OF CONTAINER IN OVEN

Figures in circles, which indicate positions, show per cent loss.

EFFECT OF CONVECTION CURRENTS

This brings up the point which is generally known, but which has never been given the proper amount of attention—the presence of convection currents set up inside the oven and their effect upon evaporation tests. The standardization of these air currents was the underlying principle of the cylindrical oven, provided with a fan, which appeared on the market some years ago. The fan was intended to produce a constant current of air through the oven. The currents varied, however, from test to test, and results were obtained as confusing as when the box type of oven was used.

An exhaustive series of tests has been made in the Municipal Testing Laboratory at St. Louis, and from the data compiled it is evident that a decided variation in result may be obtained, depending upon the position occupied by the sample in the oven. The possibility of there being any difference of temperature between various points in the oven was considered, but readings taken in all parts of the interior agreed within 2 or 3 deg. C., which is too small a variation to account for the difference in the losses. The oil used in the tests was a light road oil suitable for cold application. This class of oil usually shows a loss of 5 to 10 per cent when heated at 325 deg. Fahr. for 5 hr. Twenty grams were used in each instance. The container was of brass, 1¾ in. high and 2½ in. in diameter; its approximate weight was 40 grams. From the accompanying table and diagram it may be seen that losses varying from 4 to 16 per cent were obtained, depending upon the position occupied in the oven:

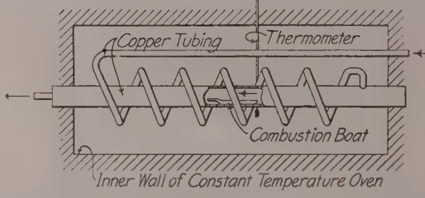
VARIATIONS IN EVAPORATION LOSS DEPENDING ON POSITION OF SAMPLE IN OVEN

	Top Shelf	Lower Shelf	Back of Oven	Middle of Oven	Front of Oven
	8.2	9.0	8.2	5.1	4.6
	4.6	8.2	9.6	6.6	6.5
	6.5	9.2	9.1	9.7	6.4
	4.5	9.9	15.8	..	4.5
	12.0	7.2	16.6	..	5.9
	5.1	4.0	12.0	..	4.4
	6.6	9.6	13.7	..	5.7
	13.7	9.1	10.8	..	4.0
	9.7	6.4	6.3	..	6.2
	5.9	15.8	9.9	..	6.4
	4.4	16.6	7.3	..	9.0
	5.7	..	8.4	..	..
	10.8	..	9.2	..	..
	6.3	..	8.2	..	..
	8.4	..	..	..	..
	6.2	..	..	..	..
	6.4	..	..	..	..
Average	7.4	9.5	10.4	7.1	5.8

The tests were repeated and the samples placed in approximately the same positions with practically the same results. The positions showing the highest and lowest losses were the same in each case. The table summarizes the results and shows that the highest losses were shown by the samples in the rear of the oven, while the samples toward the front consistently showed the lowest losses. Although no such a decided difference is noticed between the top and bottom shelves, the lower shelf seems to represent higher losses. This condition can be explained if we assume that convection currents were rising in the rear of the oven and descending in the front. In the center was a space of slight motion. This condition would cause high losses to samples placed in the rear of the oven, due to the fact that this upward draft exerts an ejecting action, drawing from the surface of the oil the volatilized fumes and thus increasing the loss.

Naturally, just the opposite effect is experienced in the front position of the oven. The descending current tends to produce a blanketing effect which would retard the carrying off of the volatilized oil, with low loss as a result. At the top of the oven there would probably be a dead air space with little or no motion. What air convection there was would pass across the top of the cans on the top shelf. This condition would tend to produce an intermediate result.

Endeavoring to confirm this view, a small section of the heating coil was replaced by a section of wire of smaller diameter, thus producing a small area which was decidedly hotter than the rest of the heating surface.



COPPER TUBE HEATER WHICH ELIMINATES OBJECTIONS OF ORDINARY APPARATUS

This set up a decided upward draft above the overheated section. Samples placed in this position of the oven showed a loss as high as 26 per cent. This might have been partly explained by the fact that the temperature was higher over this very hot section of the coil, but thermometer readings showed that in all parts of the oven except a few inches over this spot, the temperature was still uniform to within 3 or 4 deg. C., too small a difference, it would seem, to make such a large difference in volatilization.

COPPER TUBE HEATER

The only device which the writer could find described in the literature on this subject which would seem to eliminate the objectionable features of the ordinary apparatus, is that described by Archbutt & Deeley in their "Lubrication and Lubricants." It consists of a straight copper tube 2 ft. long, the shape of an ordinary combustion tube. Near one end a piece of copper tubing ⅜ in. in diameter and 10 ft. long, is brazed into it and coiled as shown in the sketch. The whole is inclosed in any constant temperature oven. A definite amount of oil, 0.5 gram, is weighed into a platinum combustion boat and shoved to the center of the tube. Air is then aspirated through the apparatus at a constant speed of 2 liters per minute during the experiment. It is preheated as it passes through the coil and is the same temperature as the oil as it passes over the boat. Remarkably close checks are claimed for this method; tests of oil showing losses as high as 15 to 20 per cent agree within 0.5 per cent in all cases. This apparatus undoubtedly eliminates the difficulty arising from ununiform air currents, but unfortunately is too elaborate and presents too many difficulties of application to warrant its extended use. Something might be evolved which would obviate the complexity of this apparatus and still secure the benefit of its principle, and place before testing engineers a method which will be free from the objections existing under the present specifications.

A FACTOR IN ASPHALT TESTING

For heavy oils and asphalts this volatility clause in the specification may not seem to be so important, but although, in the case of asphaltic cements, the actual losses usually check rather closely, the penetration and ductility on the residue vary within wide limits. This is an important factor in asphalt testing. That it is the presence of convection currents that causes this error is shown by the fact that if baffle plates are placed in the oven and solid shelves fitting closely to the side of the oven are installed, the losses are greatly reduced, and the results are in close agreement. It can plainly be seen, however, that this method results in merely a distillation and not an evaporation. A distillation test could possibly be substituted for the evaporation tests. Certainly it would be much easier to perform accurately.

At present, the two valuable factors for light road oil are volatility and viscosity, and the volatility of light oils is unfortunately the most difficult of the evaporation tests to perform. Of course, the specification for this type of oil can be changed, calling for a lower temperature at which to perform this test. This would reduce the actual error, but the percentage error would remain about the same. However, the value of this test, performed at the higher temperatures, not only on road oils but on all classes of lubricating oils, will justify a great deal of work being done to perfect it and bring it to a point where results obtained by various laboratories will be in close enough accordance to be of more use in evaluating oils than it is at the present time.

Dummies Play Important Part in Fender Tests

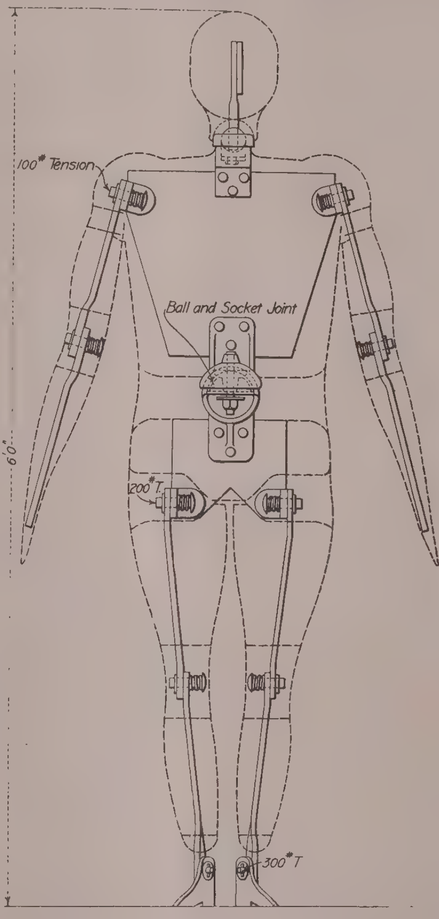
Col. Henry A. Allen, C. E. Fitch and Hugh Borland, Three Chicago Engineers, Draw Up Specifications for Motor-Truck Fenders

THREE Chicago engineers, one from the civil and two from the mechanical field, have recently completed one of the oddest engineering jobs that the city of Chicago has ever called upon its technical men to perform. This work consisted in designing several practical dummies for auto-truck fender tests, conducting the tests and then drawing up specifications for fenders that have real life-saving properties. As a result of the tests the engineers have recommended that the police reports of accidents to pedestrians by automobiles and trucks contain data on forty-six points, ranging from the type of vehicles in the street at the time of the accident to the color of the injured person's eyes. They also suggest that public speed tables be posted in various parts of the city, the tables to give the equivalents of miles per hour in feet per second so that a practical conception of speed may be obtained by the public.

In making its investigation the committee gave attention to the following points: Length of projection in front of truck, protective width, factor of traffic interference, protective height, resiliency, protective efficiency, adaptability to varying road conditions, material and workmanship, strength, durability, reliability of operation, weight, method of attachment, manner of operation, efficiency of mechanism, inconvenience to car operation, appearance, cost. The specifications were then drawn up based on the data obtained on each of these subjects.

Three sizes of specially designed and constructed dummies were used in the tests, one representing a child four years of age, weighing 35 lb., one a boy of twelve years, weighing 80 lb., and another a man, weighing 180 lb. Each fender during the dummy tests was subjected to 168 hits at speeds varying from 3 to 15 miles per hour. The dummies were subjected to more than 2500 hits.

A summary of results show that two fenders allowed no run-overs, three fenders allowed one run-over, three allowed two run-overs, one allowed three run-overs, and two allowed nine and fourteen run-overs respectively. Eliminating the last two fenders, the remaining nine give a protective efficiency against run-overs of 98.2 per cent or better. Of these nine fenders one was manually tripped all times, two were not adapted to picking up, and a fourth was unsatisfactory in general performance. This left five fenders to be considered as to their compliance with other factors of protection, as well as to the character of results of hits which were not run-overs and not liable to cause grave injury. Each fender, as previously stated, made 168 hits on the dummies, the percentage of pick-ups being more than 85 per cent for all five, one fender attaining an efficiency of 100 per cent. Forty-two of the 168 hits were made at a speed of 15 miles per hour, and the concussion the person run down would receive, regardless of any other results, was certain to be serious.



ANATOMY OF THE FATHER OF THE FAMILY

What the Tests Indicated

The committee drew the following conclusions from the tests.

1. With increased speed the protective efficiency of any fender decreases owing to the effect of concussion.

2. The efficiency of a fender greatly diminishes with increase in speed above 12 miles per hour.

3. A limit in speed can be positively, automatically controlled by various tried types of speed governors.

4. Automatic speed-control devices will not only be advantageous to the safety of the public but also to the trucks.

5. Broad, resilient surfaces of fenders tend to minimize the number of fatal accidents at all speeds, even at high speeds, because of landing a body on a large area instead of on some projecting point of the track.

6. In non-fatal accidents the liability of serious injury to a person struck is greatly reduced.

7. All fenders specially referred to are designed for and were tested under head-on collisions.

8. No fender was presented for test to prevent running in from side accidents.

9. It is doubtful whether any fender can be designed to afford complete protection at a speed of 15 miles per hour or above.

10. Designs of fenders embodying points of merit, other than those herein specially referred to, have been presented to the board, but owing either to lack of mechanical skill or other causes they have not been presented for practical tests.

11. All fenders tested have been designed for and were tested on trucks of 2 tons' capacity or over.

12. No fender has been presented for test suitable for trucks of a capacity less than 2 tons.

13. Various types and designs of fenders have been presented of high protective efficiencies.

14. The probable run-overs may be reduced to 2 per cent and serious injuries to 25 per cent by the use of proper fenders.

The committee, consisting of Col. Henry A. Allen, chairman, Claude E. Fitch and Hugh Borland, recommended that a permanent board under the supervision of the police department be appointed to conduct tests of fender devices believed by such board to warrant the conduct of tests in accordance with the recommendation of this committee and the terms of the city's ordinances and specifications. It is interesting to note that the aid of the engineers was invoked by the request of Chief Healy and Major Funkhouser of the police department.

GROSS OPERATING REVENUES FOR AUGUST on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1,191 per mile, showing an increase of $17, or 1.3 per cent, as compared with August, 1914. Operating expenses were $765, a decrease of $23, or 3 per cent. Net operating revenue, therefore, was $426—an increase of $40, or 10.2 per cent, and operating income was $375—an increase of $39, or 11.4 per cent. The gain was, however, to a large extent confined to the Eastern and Southern districts, the Western gaining only 3.9 per cent per mile. The operating ration for the whole country was 64.2 per cent, as compared with 67.1 per cent in August, 1914, and 68.8 in August, 1913. Considering the three main districts, the respective ratios for August, 1915, and August, 1914, were as follows: Eastern district, 63.6 and 67.3; Southern, 67.6 and 74.1; Western, 63.1 and 64.5.

Development of New York's Rapid Transit System Resulting in Dual Contracts

New Lines Now Being Completed After Much Legislation, Continued Litigation and Agreements Between City and Companies

THAT New York City will soon enjoy the benefits of one of the finest rapid-transit systems in the world, judged from the standpoint of efficiency in service through well-chosen routes combined with speed and capacity for handling the hundreds of thousands of passengers per day that have to be transported, is promised by the rapidly approaching completion of the comprehensive dual system planned by the Public Service Commission of the First District, New York. A history of the development of this system, its ultimate facilities and value, and the difficulties encountered in the long struggle to obtain for the Greater City adequate transportation at fair cost is of immediate interest in connection with the current descriptions of the engineering construction now appearing in this journal. The following facts have been abstracted chiefly from a paper by Daniel L. Turner, deputy engineer of subway construction, printed in the June issue of the *Public Service Board.*

Rapid Transit Commission

The first elevated railroad in New York City, and in the world, was constructed in 1868. Not until the Rapid Transit Act of 1891, however, was a self-perpetuating permanent commission empowered to lay down routes, make plans and offer fully developed perpetual transit franchises for sale at public auction established. The effective feature of the next act, passed in 1894, was the provision for municipal construction and ownership. Alexander E. Orr was the chairman of the Rapid Transit Board then created, and it was under his direction and that of his chief engineer, William Barclay Parsons, that the routes were fixed upon, the plans were prepared and contract No. 1 for the first city-owned subway was awarded to J. B. McDonald on Feb. 21, 1900.

As noted in the Engineering Record of Nov. 29, 1902, page 505, this first subway was the work of about 118 engineers. A total of about forty-six miles of underground track and about eleven miles of elevated track were completed in 1902. The shop drawings, based upon working drawings prepared in the office of the chairman of the board, were made by the steel contractor, the American Bridge Company.

Extensions to Serve Greater New York

As soon as contract 1 was under way, the board sought authority from the New York Legislature to extend its functions to all parts of Greater New York. The necessary law was enacted April 23, 1900. The board immediately prepared the plans and entered into contract 2 on July 21, 1902, providing for the extension of the subway to Brooklyn. The cost of this extension was estimated at from $8,000,000 to $10,000,000. The Rapid Transit Subway Construction Company bid $2,000,000 for construction and $1,000,000 for real estate and terminals. This led the board to believe that the great value of the operating rights was being appreciated at last, and therefore that the solution of the transit problems was at hand. Consequently it laid out a comprehensive system of routes intended to serve the whole city and endeavored to construct some of them.

The Elsberg amendments to the Rapid Transit Act, passed in 1906, although not generally recognized as having done so because construction was halted, really marked another advance step. They provided that the Board of Estimate and Apportionment should approve transit matters. Heretofore it had been possible only to construct transit lines with city money, while the new amendment made it possible also to equip and operate with city money. On the other hand, the Elsberg amendments limited the lease to twenty years with one twenty-year renewal. This was disastrous to transit progress, as capital could not recoup itself in this short time. For although city money was being used to build the subways, the carrying charges were immediately transferred to the operator, who, therefore, had to assume the cost burden practically to the same extent as if he had furnished the money in the first instance. The operator's own contribution to the project came in last. For this reason additional transit facilities were again blocked, and all further efforts of the Rapid Transit Board were in vain.

Public Service Commission

The law creating the Public Service Commission was passed in 1907. This law brought a new era. The commission for the First District, comprising New York City, was given sweeping powers of regulation and control over existing public utilities, as well as those which it brought into being. The Rapid Transit Board disappeared, and the new commission, with William R. Willcox as chairman, immediately took up the transit problems. In spite of its great powers innumerable obstacles interfered with rapid progress and it was found necessary to obtain more amendments to the Rapid Transit Act.

The defect in the Elsberg amendment was overcome in the Rapid Transit Act of 1909, which was finally passed, by recognizing that the contractor was entitled to be recouped for his expenditures before the city could exercise its short-lease privileges. Therefore it was provided, in case the city should recapture after a minimum period of ten years, that the contractor's expenditures should be returned to him with 15 per cent additional.

Another stumbling block which was disclosed by the negotiations with existing companies which were carried on by the commission and the Board of Estimate during 1910, 1911 and 1912, was the inability to amalgamate the old and the new lines into one continuous system. Consequently, in 1912, other amendments to the Rapid Transit Act were obtained, making it possible to add to the existing facilities. This was the last legislative step necessary.

Negotiations and Final Contracts

In June, 1910, the Interborough Rapid Transit Company and the Manhattan Elevated Company submitted the so-called tri-borough system proposition, described in the Engineering Record of Sept. 10, 1910, page 289. In 1911 a joint committee of the Public Service Commission and the Board of Estimate took up with the Interborough Company's officials the proposition for joint construction of new subways and equipment and operation by the company made in December, 1910. In March, 1911, the Brooklyn Rapid Transit Company made a proposition for operation over new city-built lines, and a supplementary offer in April conceded all the points demanded by the committee and previously refused by the Interborough officials. These main points included: (1) Estimating of operating expenses on cost per passenger, not on car mileage, (2) inclusion in the construction accounts of cost of real estate and easements, (3) exclusion of banking discounts from cost of construction, and (4) right of the city to transfer lines recapturable after ten years to a second operator. The Interborough Company then finally conceded the necessary points to the city, and on March 19, 1913, Edward E. McCall, the newly appointed chairman of the Public Service Commission, Theodore P. Shonts, president of the Interborough Rapid Transit Company, and Timothy S. Williams, president of the New York Municipal Railway Corporation (the Brooklyn company), signed the dual system contracts.

Dual System Construction

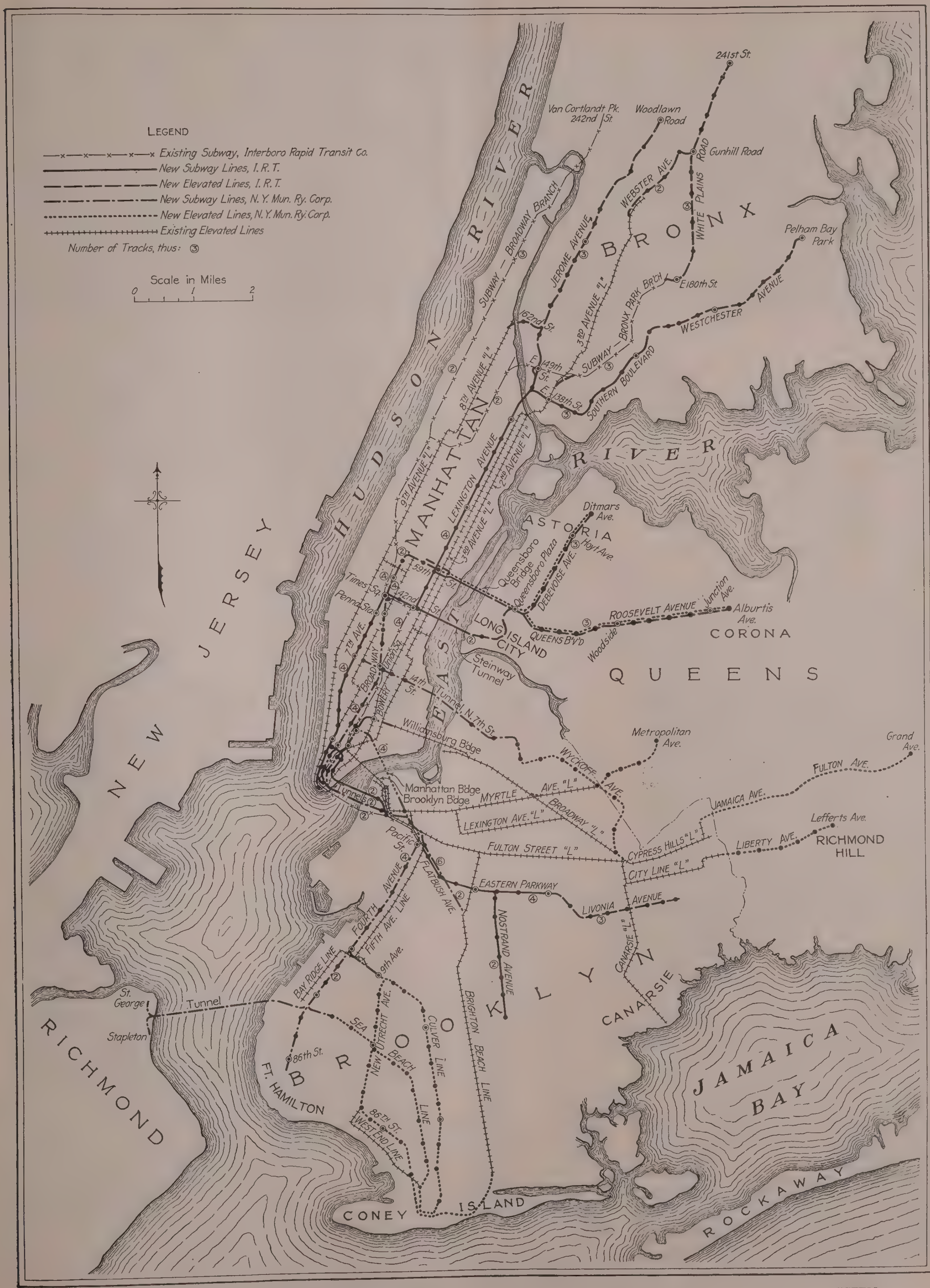
The five boroughs which constitute the Greater City, combined on Jan. 1, 1898, are Manhattan, the Bronx, Brooklyn, Queens, and Richmond on Staten Island. They form a city approximately included in a semi-circle of 18 miles radius. The real community center of the Greater City lies south of Fifty-ninth Street, between the Hudson and East Rivers in the borough of Manhattan. The active life of the Greater City, which spreads over 327 square miles, is concentrated here into an area of about 8 square miles. A comprehensive municipal transit system must join all the boroughs together and make them equally accessible to this community center. These are the chief functions of such a system from the city-plan standpoint. The dual system aims to accomplish this ultimately.

The existing Manhattan Elevated system below the Harlem River was constructed between 1868 and 1880; the Bronx portion of the Manhattan system between 1885 and 1891, and the existing Interborough subway between 1900 and 1904. These systems were designed to serve only Manhattan and the Bronx, which then constituted New York City. Similarly, the Brooklyn elevated lines, which were built between 1885 and 1894, were intended to serve Brooklyn alone.

Upon these existing lines as a foundation, the new plan has been formulated, with the primary purpose of furnishing all sections with direct service through the community center. As shown on the acompanying map, the Interborough company's system will furnish rapid transit for Brooklyn, Manhattan, the Bronx and Queens. The Brooklyn Company's system will do the same thing for Brooklyn, Manhattan and Queens, and ultimately will also serve Richmond. In this way a dual system serving the whole city has been created.

Mileage, Increased Service and Cost

The enlarged system to be operated by each company will thus consist of its existing systems extended (1) by adding



MAP OF GREATER NEW YORK, SHOWING EXISTING SUBWAY AND ELEVATED LINES AND NEW LINES OF THE DUAL SYSTEM tracks to its existing lines, (2) by extending its existing lines farther out into new territory, and (3) by constructing new city-built subways and elevated structures. The existing subway and elevated single-track mileage is: Interborough Company, 191 miles; Brooklyn Company, 105 miles; total, 296 miles. The added single-track mileage as extensions to existing lines is: Interborough Company, 21 miles; Brooklyn Company, 45 miles; total, 66 miles. The single-track mileage of the new subway and elevated systems is: Interborough Company, 149 miles; Brooklyn Company, 110 miles; total, 259 miles. The total new single-track mileage, including additions, extensions and new lines is, therefore, 325 miles, and the grand total of single-track mileage is, for the old and new lines incorporated under the dual system, 621 miles.

ROUTING

The method of routing a system has a most important bearing on its territory-serving qualities. At present there is one four-track trunk subway traversing Manhattan, as noted on the map. With the new subways completed there will be three such four-track trunk lines, with collecting and distributing branches in Brooklyn, the Bronx and Queens. All these four-track lines through Manhattan have been designed to develop a two-way traffic movement. For example, now there is a total of twelve tracks through the community center, five used by empty and seven by full trains. The dual system adds a total of nineteen tracks through the community center, five used by empty and fourteen by full trains. Thus 75 per cent of the additional tracks will be utilized for the movement of full trains.

By this means the dual system subway service alone will be nearly five times as great as the present subway service. This enormous increase in subway capacity, together with the increase in the old lines, produces a capacity for the dual system, old and new lines combined, three times as great as on the existing lines. The Greater City will be served by 332 more stations than at present; the total number of such stations will be increased from 179 to 511, or nearly trebled. Simultaneously, therefore, the dual system will practically double the single-track mileage, will treble the capacity, and will treble the territory-serving ability of the existing facilities.

To complete this project will cost the Interborough Company for construction and equipment, $105,000,000; the New York Municipal Railway Corporation for construction and equipment, $61,000,000, and the city for construction, $164,000,000; a total of $330,000,000.

The dual system not only meets the immediate requirements, but also provides for the future. Whenever new lines are needed the city can construct them, and the companies are required by their contract to operate them. The city, however, assumes any operating deficit.

Architectural Effects Secured in Glens Falls Arch Bridge Over Hudson River

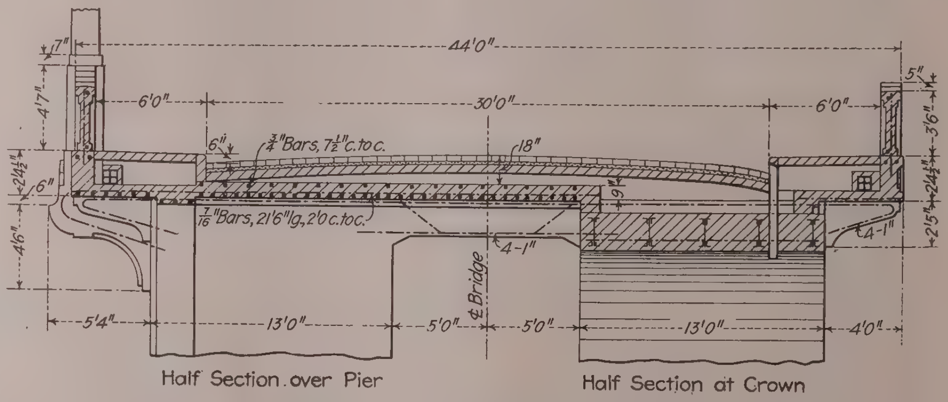
Effective Railings, Curved Brackets and a Special Spiral Stairway Feature Reinforced-Concrete Arch Bridge of Striking Appearance

THE new Hudson River bridge at Glens Falls, N. Y., combines excellent architectural appearance with comparatively low cost. Simple and effective design of the railing or balustrade and the supporting sidewalk brackets, and the use of heavy pylons at each end and graceful concrete poles to support the trolley wires, make a structure of unusual appearance. The reinforced-concrete spiral stairway on one side leading to Cooper's cave near the center of the structure is unique, and seems to merit a rather detailed description. When completed this stairway will have a bronze railing to insure safety in use and add further to the appearance.

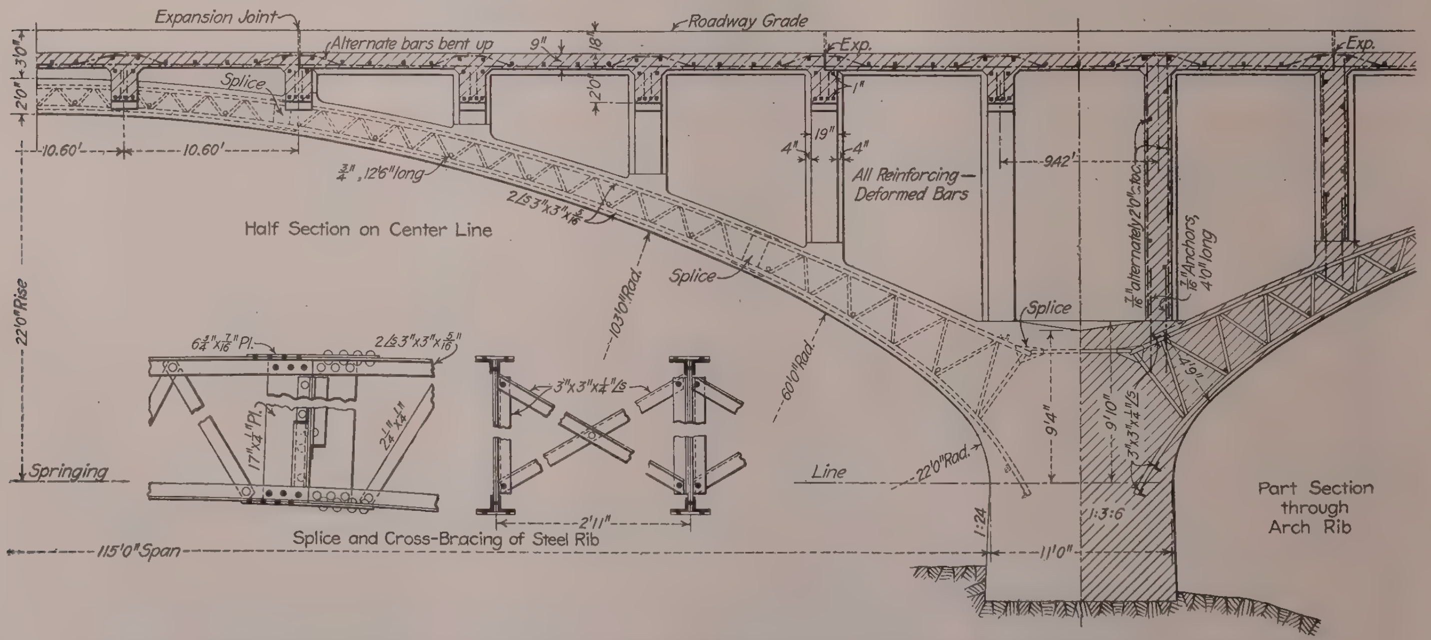
The bridge is on a main highway to Lake George and carries a single-track trolley line. It is much frequented by tourist travel, and hence the slight added expense for architectural effects is considered wholly justifiable. In order to provide continuous traffic over the old bridge at the same site, one-half of the new bridge was erected first, the roadway beams being designed to act as cantilevers until the second half was finally completed after traffic had been diverted to the half first constructed. The easterly rib was built first, and each rib constructed in three sections—the section at the crown first, then the two end sections simultaneously.

LOADS AND ALLOWABLE STRESSES

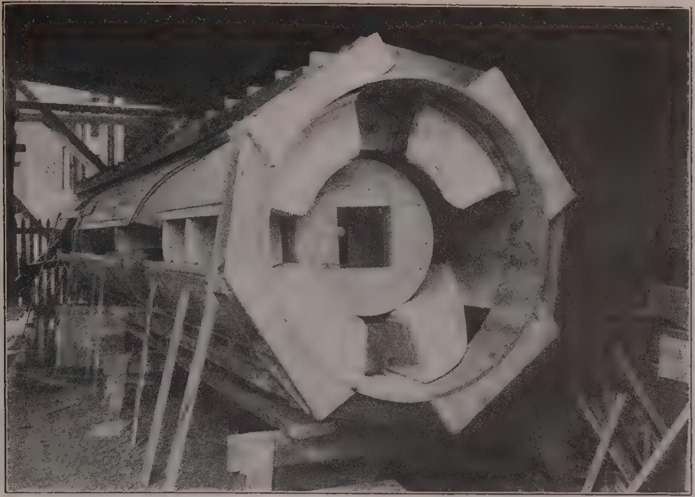
The design of each 13-ft. rib and the floor shown in the accompanying drawings was



HALF-SECTIONS SHOW DETAILS OF ROADWAY AND SIDEWALK SUPPORTS



SECTIONAL ELEVATION AND DETAILS OF BRACING FOR REINFORCEMENT OF RIBS—SPANDREL WALLS FULL WIDTH OF RIBS



SPIRAL STAIR FORMS ASSEMBLED TO CHECK FABRICATION

GRACEFUL APPEARANCE OF ARCHES—STAIRWAY TO ISLAND

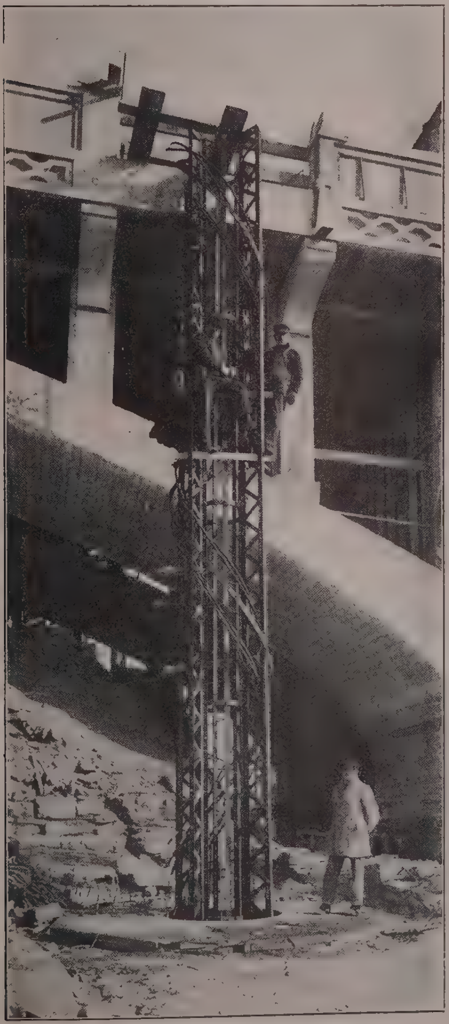
made to provide for a single 40-ton electric car on the track at the center, for 150 lb. per square foot on the balance of the roadway and for 100 lb. per square foot on the sidewalks. Three conditions of loading, as usual, were considered—dead load, half-span live load, and full live load. Each rib is assumed to carry its load uniformly distributed over the width.

The allowable stresses in the concrete are 500 lb. per square inch when temperature effects are neglected, and 650 lb. when temperature effects are included. The elastic ratio between steel and concrete was assumed at 20, and the unit stress in steel therefore does not exceed 10,000 lb. and 13,000 lb. respectively. The outline of the arch ribs was fixed after many trials, applying the elastic theory of analysis, in order to give a center line conforming as closely as possible to the lines of pressure for the three given conditions.

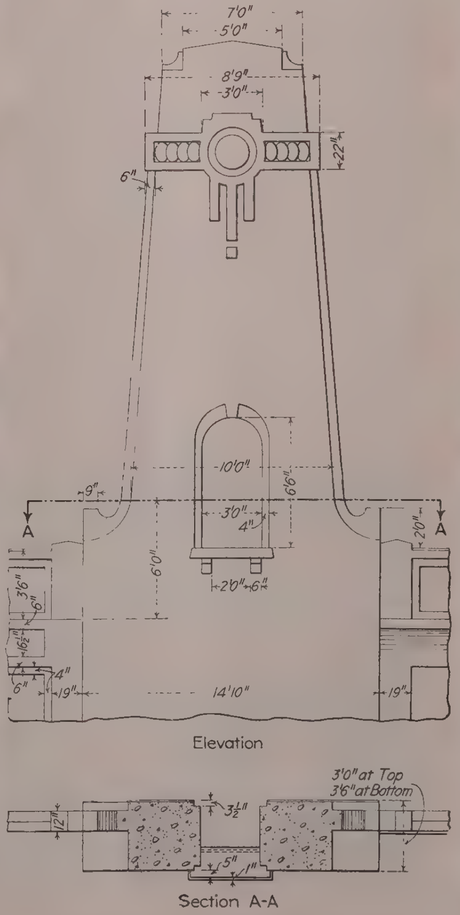
MATERIAL AND PROPORTIONS

The concrete used in the structure was of three grades: (a) 1:2:4 mixture, with broken stone passing a 1½-in. ring, used for the arch ribs between skewbacks, for floor slabs, girders and brackets, for the upper 4 ft. of the transverse walls cast as a monolith with the girders, and for copings, cornices, parapet walls, railings and lamp posts, sidewalks and curbs; (b) 1:3:6 mixture, with broken stone passing a 2-in. ring, used for spandrel walls, transverse walls that do not carry brackets, and for the lower parts of transverse walls which do carry brackets; (c) 1:3:6 mixture, with broken stone passing a 3-in. ring, used for foundation courses and retaining walls, and for abutments, piers and pylons.

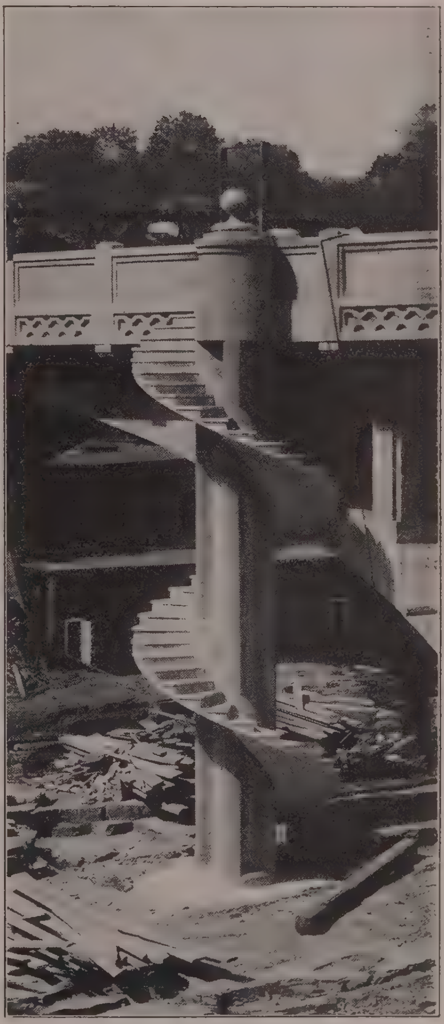
Expansion joints located as shown on the accompanying drawings marked the points for discontinuity in placing the concrete, and the walls were carried up to the bottom of the floor slabs. A single layer of two-ply tarred felt was used in the hori-



STEEL REINFORCEMENT FOR MAIN SHAFT OF SPIRAL STAIRWAY



DETAILS OF ORNAMENTAL PYLON



ORNAMENTAL SPIRAL STAIRWAY
Handrail of bronze to be added

zontal expansion joints, and vertical expansion joints ½ in. wide were filled with tar paper and pitch.

Details of Arch Construction

The bridge extends in a north-and-south direction and consists of six arch spans, one with a clear span of 90 ft., four with clear spans of 115 ft., and one with a clear span of 60 ft. The retaining walls at the north end are 84½ ft. long, and at the south end one retaining wall is 110 ft. long and the other 41½ ft. long. The total length of the reinforced-concrete structure is 679 ft.

The arches are of the Melan type, the accompanying elevations and sections of the 115-ft. span showing the typical details used. The method of supporting the 30-ft. brick roadway is on concrete slabs by spandrel walls over the two 13-ft. ribs and by reinforced-concrete beams between them, and the cantilever brackets for the two sidewalks are used throughout the bridge except for the arched approach span at one end. One photograph shows the general appearance of the structure; the solid spandrel approach span just mentioned and the large ornamental pylons are at the far end.

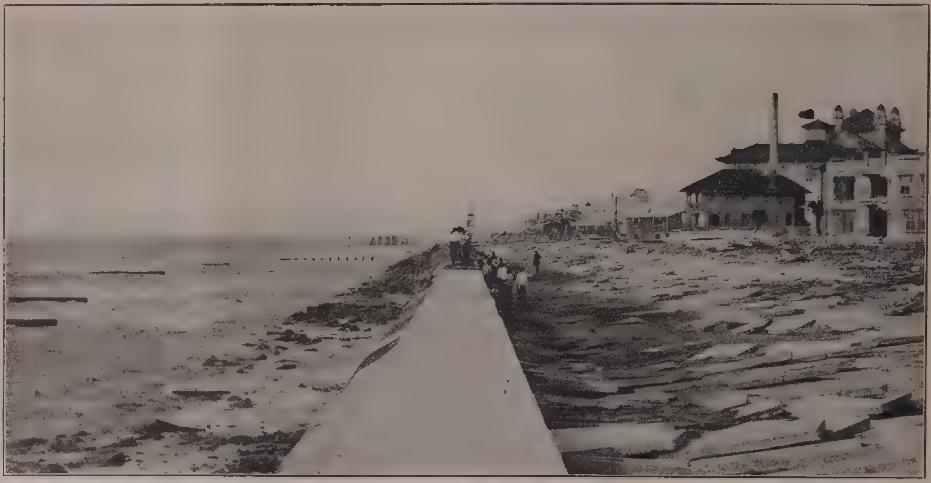
Spiral Stair to Island

The island seen in the center of the picture is largely composed of solid rock, and contains a cave called Cooper's Cave, which is somewhat of a curiosity. Access to this island was furnished by the ornamental reinforced-concrete stairway which is shown by the photographs. Some idea of the complicated nature of the form construction is given by the view of the assembled form boxes, which were built in separate units and erected around the steel frame, seen in the other photographs, inside the shell shown partly completed in the trial assembly on the ground.

The four main ribs of the vertical central column of this stair, which makes exactly two complete turns, were each reinforced by two angles laced together and held in place by the five circular hoops shown in the photographs. Five spiral rods and a spiral band reinforce the inside of the steps, and four horizontal rods to each step, not shown in the picture, were cast with the main column, and designed to support the loads by cantilever action. Special attention is called to the smooth finish of these steps, and the beading on the forms, which gave excellent results. The total cost of this stairway, including the bronze handrail not shown, was about $4,000. This is only 2.7 per cent of the total cost of the structure, which was about $150,000.

The bridge was designed by the Concrete-Steel Engineering Company of New York, and its construction supervised by E. H. Harder, resident engineer of that company, It was constructed by Callanan & Prescott, contractors, of Albany.

Dayton's New Garbage-Reduction Plant will have a novel dryer with the feed end maintained at a cooler temperature than usual. The idea is to save an additional amount of grease, according to a statement by J. E. Barlow, director of public service, in a paper presented to the American Society of Municipal Improvements. No attempt will be made to recover the "stick" liquor, which will be run out over gravel. The plant will have a capacity of 50 tons per eight-hour shift.



THIS DESTRUCTION IS ATTRIBUTABLE TO FAILURE TO PROTECT THE SAND BEYOND PAVEMENT WITH SODDING

Galveston Adopts Plan to Strengthen Its Waterfront Defense Against Future Storms

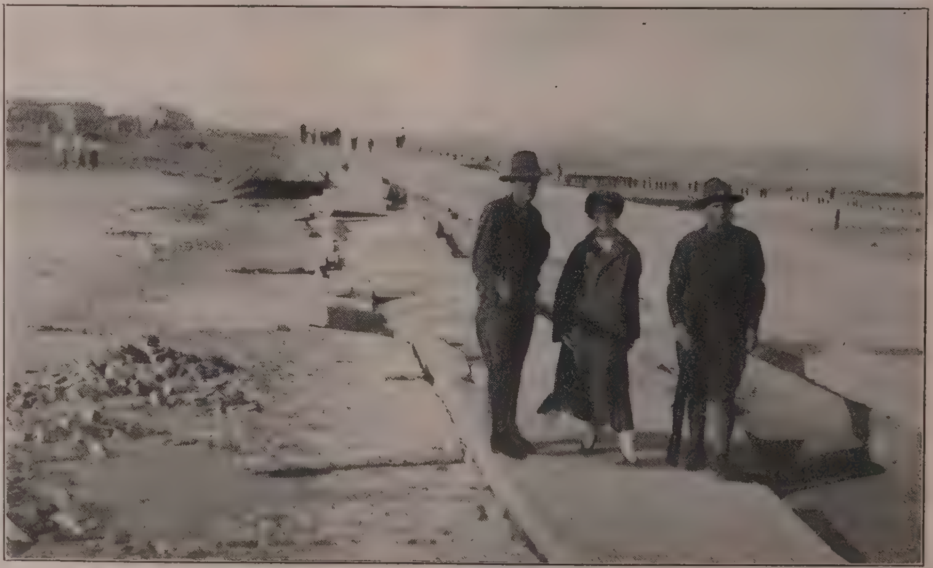
Fill Back of Sea Wall to Be Retained by Fourteen-Foot Concrete Bulkhead at Edge of Brick Pavement

FOLLOWING the severe storm of Aug. 16-17, this year (see Engineering Record, Aug. 28, 1915, page 271), Galveston County, Texas, called in Brig.-Gen. H. M. Robert, U. S. A. (retired), to advise on the measures necessary to prevent again the destruction of the boulevard pavement back of the sea wall. General Robert reported, under date of Oct. 11, advising that the present brick pavement be widened 30 ft.; that is, extended to a distance 100 ft. back from the back of the wall, and that at its edge there be built a reinforced-concrete sheet-pile bulkhead, 14 ft. deep, to prevent undermining. This plan has been adopted by the county. The recommendation that 20,000 tons of rock be placed at the toe of the sea wall to protect it from undermining, and from exposing the first row of piles and the wood sheeting to the ravages of the teredo, has also been adopted.

As noted in the Engineering Record of Aug. 28, the sea wall itself suffered no damage, other than the washing away of sand beneath the toe. However, the water blown across the top churned away the sand beyond the pavement wherever it had not been protected by sodding and planting to Bermuda grass. For a length of 6000 ft. it undermined and destroyed not only the full width of pavement, 54 ft., but also the 16-ft. sidewalk, leaving at some places a sheer drop of 6 ft. to the sand at the back of the sea wall. In other places only part of the pavement was destroyed.

Plan Adopted

The plan adopted provides for paving the full width of the county's right-of-way, 100 ft., for its entire length of 14,000 ft., and placing along the outer edge a reinforced-concrete sheet-pile bulkhead, 14 ft. deep and 6 in. thick. This will have a concrete cap, 12 to 15 in. thick and 30 in. wide. Tie rods, 10 ft. apart, will run to a continuous 8 x 12-in. reinforced-concrete deadman buried beneath the pavement 20 ft. back from the bulkhead. Since the greatest depth of scour was 6 ft., General Robert considers a 14-ft. bulkhead ample. By this construction the sand back



AS THIS PICTURE CLEARLY SHOWS, THE BOULEVARD PAVEMENT BACK OF THE SEA WALL WAS DESTROYED BY UNDERMINING STARTING THE BACK EDGE

ANOTHER VIEW SHOWING UNDERMINING FROM REAR—IN PLACES THE BRICK PAVEMENT, CEMENT GROUTED, CANTILEVERED 12 FEET

of the sea wall is fully inclosed, the sea wall and bulkhead protecting front and back and the pavement the top. The pavement will be of the same type as that now used —vitrified brick laid on a hydraulically placed sand, and using cement-grout filler. This construction has given very satisfactory results, part of the pavement laid by this method in 1903 being still in place and in excellent condition. In fact, the only sections of original pavement not now in place are those where grade changes were necessary or where the storm undermined and destroyed them.

It will be noted from the drawings that the pavement grade is made 2 per cent toward the Gulf, thus giving an elevation of 19 ft. at the back edge. This uniform grade will continue down to the top of the sea wall, thus allowing prompt escape of the water. For 75 per cent of the length, however, the sidewalk edge will be raised 4 in. to prevent vehicles from running onto the walk.

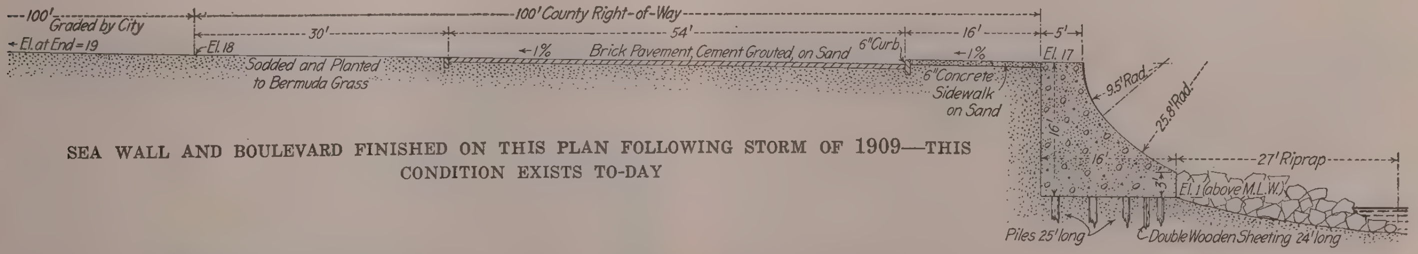
The new construction, so far as grades are concerned, is to be applied only where the boulevard has been washed out.

In his report General Robert emphasizes the necessity of planting with Bermuda grass the space beyond the 100-ft. boulevard. This recommendation has been made before, but was generally disregarded. Where this protection was provided there was no undermining, and had it been general there would have been little damage to the boulevard. This matter, however, is beyond the control of the county, and is under the city's authority. The protective power of the Bermuda sod was plainly shown wherever the lawns were cut by shell or sand drives or walks. These were points of weakness. Undercutting started at them, spread under the pavement and to both sides. At the sides, however, the resistance of the sod was so great that the destruction did not go far.

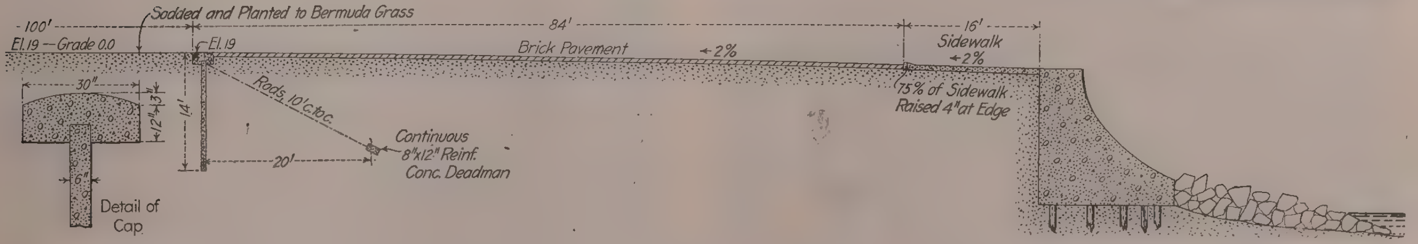
The sodding is accomplished by putting over the sand a 4 or 5-in. layer of loam and planting tufts of Bermuda grass at the corners of 4-ft. squares.

While so far as the county's right-of-way is concerned the recommendations have been adopted, the report points out that the sod protection should be carried back, if possible, to a distance 300 ft. from the sea wall. Further, it has been suggested that at the back edge of the pavement, there be placed a clay mound 2 ft. high and 5 ft. wide at the base and that back of it and from its top there be carried for 100 ft. a 2 per cent grade, the slope to be planted to Bermuda. This would give a ground elevation 200 ft. back from the wall of 23 ft., 6 ft. higher than the wall, thus effectively protecting the city from water from the Gulf. Some water did come over from this direction in the August storm. General Robert heartily indorses the suggestion. Its execution would depend on the city, but sentiment in Galveston is hardly such as to insure the carrying out of the work.

The new work will be carried out under the direction of R. M. Sias, county engineer.



SEA WALL AND BOULEVARD FINISHED ON THIS PLAN FOLLOWING STORM OF 1909—THIS CONDITION EXISTS TO-DAY


Sodded and Planted to Bermuda Grass
100'
El. 19 — Grade 0.0
El. 19
84'
Brick Pavement
2%
16'
Sidewalk
2%
30"
12"
3"
14'
Rods 10' c. to c.
20'
Continuous 8"x12" Reinf. Conc. Deadman
6"
Detail of Cap
75% of Sidewalk Raised 4" at Edge

PLAN RECOMMENDED OCT. 11, 1915, AND ADOPTED INCREASES WIDTH OF PAVEMENT AND PLACES CONCRETE BULKHEAD AT REAR EDGE

Urge Construction of Pacific Coast Military Road

As an echo of the resolutions recently passed by the Pan-American Road Congress in Oakland, Cal., a San Francisco newspaper prints the following communication, received from a local engineer, urging the construction of a Pacific Coast military road:

"One of the most important elements in a comprehensive scheme of defense of an extended coast line is the existence of an adequate system of lines of communication. While the value of railways for this purpose will always be great, the relative importance of good highways has been vastly increased by the introduction and general use of the many forms of motor-propelled vehicles.

"During our Civil War campaigns were planned only for those seasons of the year when normal weather conditions promised passable roads. Even then operations of vast import often were aborted or impeded by untimely rains. Now that the consumption of munitions is on such an enormous scale the problem of transport, always a difficult one, is far more serious than formerly. Clearly the army mule—our main reliance in the past—will be wholly inadequate in the future. Moreover, although the mule team could be utilized to some extent even on the worst of muddy roads, the use of motor vehicles makes good roads absolutely indispensable. These, of course, must be constructed before the outbreak of hostilities.

"Without doubt any attempt at actual invasion of our western mainland would be aimed at San Francisco, at once the commercial and financial metropolis of the Pacific Coast and the point of greatest strategic value upon our entire coast line. It is a matter of simple prudence, therefore, that every possible landing place within practicable distance both north and south of San Francisco should be made readily accessible to our defending army by means of easy and permanent roads. The trunk line of this system should be located out of range of observation and of gun fire from the ocean, with branches leading to all positions commanding the landings that would be occupied by our forces. It would, therefore, seem highly desirable to invite the co-operation of the National Government in this matter. A recommendation to Congress on the subject would be timely and quite in order."

Tests Show How Loads Are Distributed on Reinforced-Concrete Slab Floors

Percentages of Concentrated Loads Above Joists Carried by Adjacent Joists and Effective Width of Slab Determined

OWING to the indeterminate nature of the distribution of the actual concentrated loads on highway bridge floors, and in order to obtain test data upon which rational design of reinforced-concrete slab floors can be made, three series of tests have been conducted by the highway department of the State of Ohio. The results are published in Bulletin 28 of the department, recently issued. Both laboratory and field tests are included—one laboratory series and one field series to investigate the distribution of concentrated loads to the joists, and one laboratory series to determine the load distribution across the slab and the effective width. The abstract which follows includes the principal results and the final general conclusions which seem to be justified by the tests.

With the exception of the dead loads, practically all heavy loads, such as the wheels of a road roller or heavy motor truck, on highway bridge floor are concentrated on small areas. In the design of reinforced-concrete floors, therefore, there are two assumptions which must be made: (1) In designing the supporting joists or stringers, the proportion of a concentrated load on the slabs carried by the joist immediately below it; (2) in designing the floor slab itself, the width of the slab which may be considered as carrying a concentrated load resting upon it. A satisfactory theoretical solution of these questions is impossible, as it involves the elastic properties of concrete and steel in flat slabs and beams with multiple supports, and requires so many assumptions that any results thus obtained would be little better than assuming the distribution at once.

Tests for Load Distribution to Joists

The laboratory tests for determining the distribution of concentrated loads to supporting joists were made on 5 x 8-ft. slabs. Two 6-in. slabs, one 7-in. slab and one 8-in. slab with ¾ per cent reinforcing, and the same series with 1 per cent reinforcing, were made. All but two were also reinforced with a layer of wire netting of 6-in. mesh, made of No. 9 and No. 11 wire. The main reinforcing rods were placed parallel to the 8-ft. dimension of the slabs, which were cast on three lines of 10-in., 25-lb. I-beams as joists, spaced 3 ft. 6 in. center to center. These beams were supported on end I-beams 12 ft. apart corresponding to floorbeams in a bridge, as shown in one of the accompanying photographs. The I-beam joists were supported on ¼-in. rods as knife edges on the top of the cross beams.

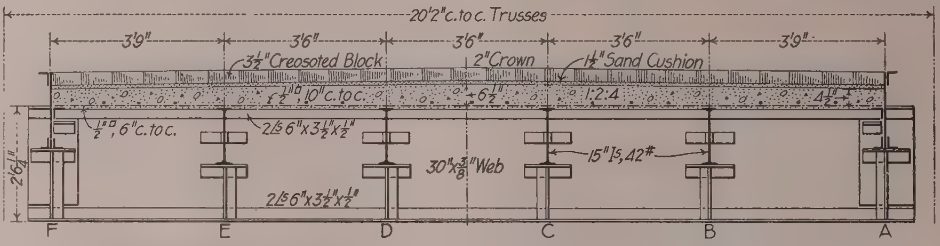
The load was applied to a paving brick bedded in mortar at the center of the slab over the middle joist, by means of a simple beam acting as a lever. An upward pressure was exerted on the lever on one end through a screw jack resting on the weighing table of the testing machine, which produced a downward pressure at the other end on the brick. The lever was held down between the slab and the testing machine by two 1¾-in. rods anchored into the floor.

During the tests, both the elongations of the extreme fibers of the I-beam joists and the deflections at the middle were taken. Calibration runs were made on each beam without the slab with a single concentrated load in the middle, for the purpose of determining the value of the coefficient of elasticity for each beam. The slabs were centered on the 12-ft. span and bedded in cement mortar spread on the tops of the I-beam joists in order to secure an even bearing on all the beams. The test loads were applied in increments of 2000 lb. until a total of 20,000 lb. was reached.

Results of Laboratory Tests

The results of these tests, in terms of equivalent uniform load (assumed distributed over the 5-ft. length of bearing of the slab) computed from the elongations of the lower fibers of the I-beams, and the percentages carried by each beam, are given in Table 1. The percentages carried by the middle beam are shown in the accompanying diagram. The results given are based upon the 20,000-lb. load, as the curves between load and deformation and load and deflection both very closely approximate straight lines, and therefore the equivalent loads will be fixed percentages of the total load for each test and the percentages will not vary with the amount of the load.

It is worthy of note that in Table 1 the sums of the three percentages given for each test are less than 100 per cent, or in other words, that less than the whole of the load is accounted for by the assumption of the 5-ft. uniform distribution along the joists.



CROSS-SECTION OF THE HIGHWAY BRIDGE FLOOR WHICH WAS TESTED

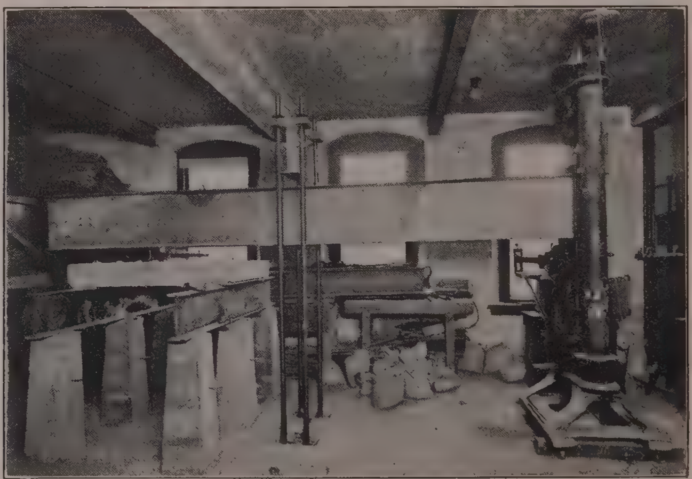
Field Tests

A series of tests were made on the floor of a ten-panel Warren truss bridge, 205 ft. long, center to center of end pins. The roadway is 18 ft. wide between curbs. The floor is a reinforced-concrete slab supported on I-beam joists, shown in the accompanying cross-section, with a floor surface of creosoted wood block laid on a sand cushion. Since the thickness of the slab varies from 4½ in. at the curb to 6½ in. at the middle, the reinforcing rods shown give 1.19 per cent reinforcing at the curb and 0.76 per cent at the middle.

To determine the load distribution to the joists, the load was applied through a paving brick directly over the middle of the I-beams at points *D* and *E* in each of the two panels adjacent to the center of the bridge, by means of a 25-ton screw jack acting on the foot of a V-frame, which was hung from the adjacent top struts of the upper lateral bracing. The arrangement is shown in one of the photographs.

The amount of load applied was determined by inserting a spring device between the jack and the bridge, as shown in the photograph. This spring was made of two 10 x 1 11/16-in. plates separated by ⅝-in.

ARRANGEMENT FOR TESTING LOAD DISTRIBUTION TO JOISTS



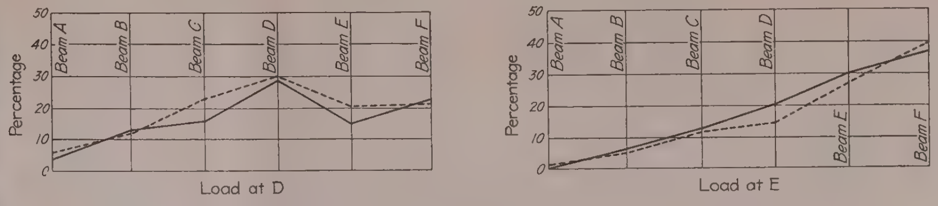
APPLYING A CENTRAL LOAD TO A CONCRETE SLAB

APPARATUS FOR LOADING BRIDGE FLOOR

fillers at the ends. On each side was fastened a deflectometer which magnified the deflection of the plates 100 times and was read directly on a scale attached to the instrument. It was calibrated up to a load of 20,000 lb. and was sensitive enough to indicate increments of 200 lb. The loads were applied in 5000-lb. increments up to a total of 20,000 lb. at each point. The elongation of the lower fiber of each joist at the middle of the panel was measured with a strain gage.

TABLE 1—EQUIVALENT UNIFORM LOADS AT 20,000-POUND LABORATORY TEST LOAD BASED ON ELONGATION OF LOWER FIBERS—PERCENTAGES TO EACH JOIST

Thickness, in.	Reinforcement, per cent	Age in days	Load uniformly distributed over 5 ft. for beam				Percentages for beam			
			A	B	C	Sum	A	B	C	Sum
6	¾	497	4,480	9,990	4,800	19,270	22.4	50.0	24.0	96.4
6	¾	491	4,360	10,350	4,490	19,200	21.8	51.7	22.5	96.0
7	¾	498	4,430	6,220	4,540	15,190	22.2	31.1	22.7	76.0
8	¾	495	4,480	4,970	4,440	13,890	22.4	24.9	22.2	69.5
6	1	327	4,480	9,030	4,890	18,400	22.4	45.2	24.5	92.1
6	1	187	3,960	10,350	4,020	18,330	19.8	51.8	20.1	91.7
7	1	325	4,790	7,050	4,540	16,380	24.0	35.3	22.7	82.0
8	1	607	4,530	7,290	4,510	16,330	22.7	36.4	22.6	81.7
8	1	142	5,000	6,520	4,020	15,540	25.0	32.6	20.1	77.7



AVERAGE COMPUTED PERCENTAGES CARRIED BY EACH BEAM OF BRIDGE FLOOR

EQUIVALENT UNIFORM LOADS

Assuming the coefficient of elasticity to be 30,000,000 and reducing the readings to equivalent uniform loads, the values given in Table 2 for the 20,000-lb. load are found. The sums of these equivalent loads given in the last row indicate that the applied loads are nearly uniformly distributed to the beams, as the totals check well with the total load applied.

The equivalent uniform loads are reduced to percentages of the applied loads, the weighted average is computed for each point and plotted in the accompanying diagram.

SPECIAL CONDITIONS IN THIS TEST

While it has been shown that the deformation in the joists accounts for the total load applied if considered uniform, it is well to inquire whether some unusual conditions conspired to make the concentrated load develop only as much stress as would have been expected had the load been applied uniformly along the joists. It should be noted that in the case of this bridge the floor joists are made fast to the web of the floorbeams, a condition which, together with the continuity of the concrete over the top of the floorbeams, tends to restrain the ends.

For perfect fixed-end conditions a concentrated load at the center will produce a bending moment equal to that produced by the same weight uniformly distributed over a beam without fixed ends. Since the concrete slab is cast partly around the top flange of the I-beam, it may act as a composite beam, depending on whether or not the bond between the concrete slab and the steel flange has ever been broken. These conditions offer an explanation why an actual concentrated load stressed the bottom fiber of the I-beam an amount that would ordinarily have been calculated for the same load uniformly applied. The designer should compare his conditions with those herein described before assuming a longitudinal distribution equivalent to that indicated by the test.

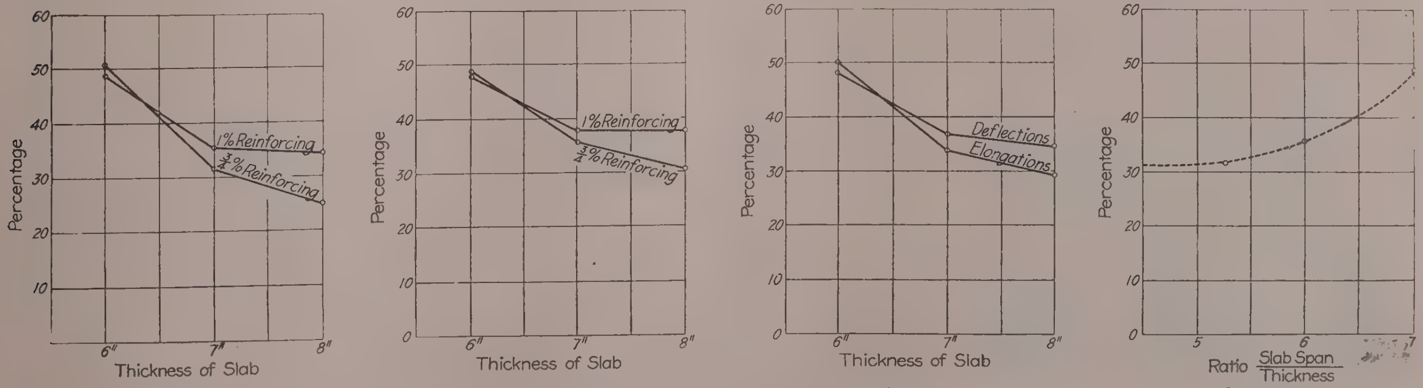
TABLE 2—EQUIVALENT UNIFORM LOADS FOR JOISTS UNDER 20,000-POUND LOAD IN FIELD TEST

Joist	Panel east of center		Panel west of center	
	Load at D	Load at E	Load at D	Load at E
A....	1,180	0	1,480	500
B....	2,340	1,090	2,200	1,460
C....	3,140	2,550	4,240	2,200
D....	5,780	4,020	5,860	2,920
E....	3,580	5,860	3,880	5,640
F....	4,620	7,160	4,520	7,860
Sum..	20,640	20,680	22,180	20,580

CONCLUSIONS REGARDING DISTRIBUTION TO JOISTS

The following conclusions regarding the distribution of the concentrated loads on a reinforced-concrete slab to the floor joists seem to be warranted by these tests.

1. The percentage of reinforcement has little or no effect upon the load distribution to the joists, so long as safe loads on the slab are not exceeded.
2. The amount of load distributed by the slab to other joists than the one immediately under the load increases with the thickness of the slab.
3. The outside joists should be designed for the same total live load as the intermediate joists.
4. The axle load of a truck may be considered as distributed uniformly over 12 ft. in width of the roadway.
5. If the slab has ample grip on the upper flange of the I-beam and is continuous over the floorbeams, and if the joists are riveted to the webs of the floorbeams, the live-load stress in the joist may be but one-half as great as for a similar load on a plain I-beam supported at its ends.
6. Under these favorable conditions the axle load in a panel of not more than 20 ft. may be assumed as uniformly distributed over two-thirds of the length of the joists to be considered as simple I-beams sup-



From Elongations

From Deflections

Averages

A Possible Curve

PERCENTAGES CARRIED BY MIDDLE BEAM B COMPUTED FROM EQUIVALENT UNIFORM LOADS BASED ON SLAB TESTS ported at the ends. Without these conditions, the load may be assumed as uniformly distributed over a length of at least 5 ft.

DISTRIBUTION OF CONCENTRATED LOAD OVER SLAB

To determine what width of a reinforced-concrete slab may be considered in designing for concentrated loads, and how far from the point of concentration the load causes stresses in the slab, a series of laboratory tests on three spans, 3½ ft., 5 ft. and 7 ft. were made. Twenty slabs were made and tested, of which fourteen were 7 in. thick and six were 4 in. thick. Various percentages of transverse reinforcement were used. The main reinforcing of all slabs was 1.04 per cent, placed with the center 1 in. above the bottom of the slab.

The concentrated load was applied through a brick at the center of the slab in the same manner as previously described. A photograph of the apparatus is shown. Observations were made of the deflections and of the deformations in the concrete and the steel.

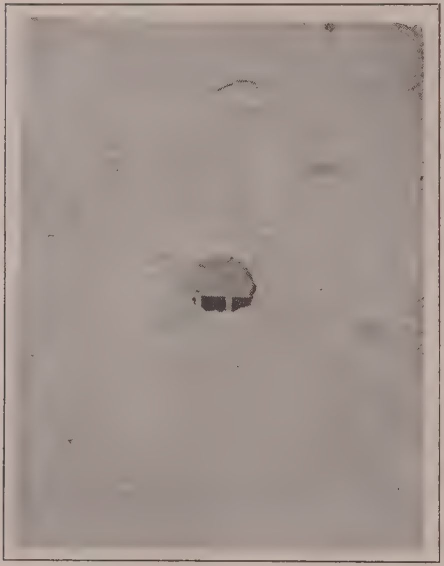
TO DETERMINE EFFECTIVE WIDTH

Defining "effective width" as that width used in designing over which a single concentrated load may be considered uniformly distributed on a line down the middle of the slab parallel to the support, two methods of obtaining this width may be used:

1. The loads causing known deformations in a 1-ft. slab may be used as units for comparison with loads causing equal maximum deformations in the other slabs.

2. The deformations on a transverse section (parallel to supports) may be plotted for any load, and the area under this curve divided by the maximum ordinate to the curve (maximum deformation) will give the effective width.

A material like concrete, with many variations in hand mixing, is so variable that it is thought that the results obtained by the first method are not entirely reliable.



TOP OF SLAB AFTER FAILURE

BOTTOM OF SLAB AFTER FAILURE

EFFECTIVE WIDTHS FROM DEFORMATION CURVES

The deformations of the steel and the concrete and the deflections of the slab, on a transverse line down the middle of the slab, were plotted for each load and slab. The area under any one of these curves divided by the maximum ordinate to the curve will give a value of the effective width of that slab for that load. Thus three values of the effective width, one from the deflection, one from the deformation of the concrete and one from the deformation of the steel, are obtained. In nearly all cases the concrete deformation gives a less effective width than either of the others, and the greatest effective width is given by the deflections.

It was found that, in testing, the slabs left the outer edges of the I-beams, due to deflection, showing that the effective span was about equal to the clear span. Table 3 gives a summary of the effective widths in percentages of the clear span, based on unit deformation in the concrete.

TABLE 3—EFFECTIVE WIDTH IN PERCENTAGE OF CLEAR SPAN BASED ON UNIT DEFORMATION IN CONCRETE

Number tested	Thickness, in.	Clear span	Width, ft.	Transv. reinf., per cent	Average, days	Percentage effective width at a unit deformation of				Average up to 0.001	
						0.0006	0.001	0.0016	0.002	per cent	in.
3	7	3 ft. 1 in.	3.5	Varies	104	98.5	96.0	91.4	91.3	98.1	36.3
3	7	3 ft. 1 in.	7.0	Varies	135	119.6	125.1	113.3	109.2	121.7	45.0
3	7	4 ft. 7 in.	5.0	Varies	146	88.7	83.9	79.3	78.3	87.6	48.2
1	7	4 ft. 7 in.	10.0	0.2	146	107.0	101.6	89.7	85.0	105.8	58.2
1	7	6 ft. 7 in.	7.0	0.2	147	78.3	70.5	65.7	64.0	76.2	60.2
1	4	3 ft. 1 in.	5.25	0.4	42	108.1	108.0	109.0	105.8	107.1	39.6
1	4	3 ft. 1 in.	7.0	0.4	126	113.9	103.6	95.2	92.7	111.7	41.3
1	4	4 ft. 7 in.	7.5	0.4	43	95.2	95.1	86.8	84.0	95.6	52.7
1	4	4 ft. 7 in.	10.0	0.4	80	98.1	96.1	90.9	85.3	98.1	54.0

All of the slabs failed by shear—that is, by the brick punching through the slab. Views of the failure of one of the slabs are shown herewith.

RESULTS AND EMPIRICAL FORMULA

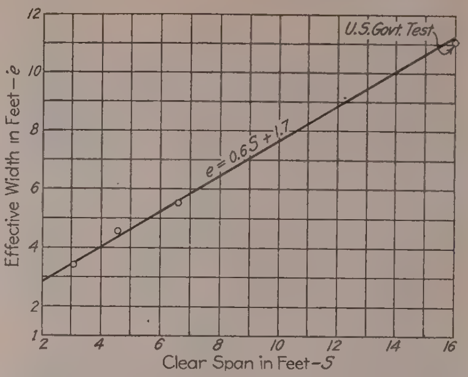
The results shown in the table indicate a decrease in effective width as the load increases, but this is not marked until after safe loads are exceeded. The effective widths in inches given in the last column are the averages for seven values for deformations up to 0.001 per inch, which corresponds to a unit stress of about 1500 lb. per square inch in the concrete. This is well beyond the safe working values.

The accompanying diagram shows the values of the effective width plotted with the clear span. It is seen that a straight line fits these points fairly well, and until further data are available the following equation may be used with safety:

$$e = 0.6S + 1.7$$

where e is the effective width in feet of a slab of greater width than length, and S is the clear span in feet.

This equation is independent of the thickness of the slab. It is worthy of note that the results for the 7-in. and 4-in. slabs indicate that the thickness has some effect on the effective widths, but the effect is small and further experiments would be necessary to determine its value.



EFFECTIVE WIDTH OF SLAB UNDER CONCENTRATED LOAD

Tests on the floor slabs of the 205-ft. highway bridge used for the field tests were made, and the effective width was found to average about 4.5 ft. The equation gives about 3.9 ft. and therefore errs on the safe side.

CONCLUSIONS REGARDING EFFECTIVE WIDTH

These tests of slabs seem to warrant the following conclusions:

1. The effective width is affected very little by the percentage of transverse reinforcement parallel to the supports.

2. It decreases somewhat as the load increases.

3. In percentage of the span it decreases as the span increases.

4. The foregoing formula will give a safe value of effective width where the total width of the slab is greater than 1 1/3 S + 4 ft.

The first series of tests cited was made by G. R. Logue and R. H. H. Spidel, in the testing laboratory of the Ohio State University. Acknowledgment is made of the valuable services rendered by Prof. C. T. Morris and Prof. W. S. Hindman in conducting the tests, which were made under the supervision of Clinton Cowen, State highway commissioner of Ohio, and J. R. Chamberlain, deputy of bridges.

COAGULANT REQUIRED AT ERIE, PA., for the first six-month period of operation of the new rapid filters varied from 0.15 to 0.6 grain per gallon, averaging 0.37 grain. The variations, according to J. S. Dunwoody, superintendent of filtration, were more for experimental reasons than a necessity. The chemical is controlled automatically within 0.006 grain per gallon. Bacteria in the supply average 749 per cubic centimeter, and in the effluent 9. Complete sterilization was effected by using 4.85 lb. of bleach per million gallons. Turbidity of the supply averaged 18 parts per million, varying from 3 in July to 48 in November. Wash-water averaged 3.22 per cent of the net amount filtered.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Handling Collapsed Sewer Adjacent to New Trunk Line

PARALLEL to the open-cut section of the 16½ x 16½-ft. Mill Creek sewer in St. Louis is an old 4 x 5-ft. brick sewer in poor condition, which has collapsed at several points during construction. Although the two sewers are but 8 ft. apart, it was decided to retain the existing conduit as a sanitary sewer because it carries particularly offensive gas wastes. The photograph shows a typical break. The repair is made by pulling up the steel sheet piling far enough to drain the old sewer into the new one. The ground over the break is then excavated and the old sewer repaired. In order to provide for handling a possible future break in that part of the old sewer already passed, a"Y" has always been built into the new sewer at each break.

EXCAVATING BEHIND STEEL SHEET PILING TO REPAIR COLLAPSED BRICK SEWER

C. L. French is resident engineer of the first section along which the brick conduit occurs.

Improvements in Use of Unloader Plows Developed at Panama

THE UNLOADER plows, used to clear continuous trains of flat-cars of dirt in disposing of material excavated in the dry at the Panama Canal, were covered top and bottom with sheet steel. To save digging the dirt off of aprons accidentally thrown back and covered in loading the cars, a short chain with a hook and a cable grip was used to attach the aprons to the moving unloader line and throw them in advance of the plow. A stretcher frame was erected over the track at the inner end of each dump to overhaul the unloader cable. The cable was attached to this frame by a chain having a soft link and a slip link. These features, which saved much time and trouble in using unloader plows in the Canal Zone, were brought out by Maj.-Gen. George W. Goethals in a paper presented recently to the International Engineering Congress.

When first used on the canal work, the unloader plow was a skeleton with a plate wing. It was weighted down with from 7 to 10 tons of ballast in order to keep it on the bottom of the cars and to prevent it from riding over the spoil. Pieces of rock were continually working under the bottom and over the top of the plow, and as there was no way for the débris to escape except by being ground out, constant damage was done to the car floors and trouble was also caused by the débris catching in the aprons. The plow was covered with sheet steel on the top and bottom and thus the small rock was excluded, while, by an adjustment of ballasts along the share of the plow, 3½ tons of weight were found sufficient to hold the plow on the floor, entirely overcoming its tendency to rise. At first it was necessary to spend several minutes in digging out the end of the cable attached to the plow from the spoil along the face. This waste of time was eliminated by forming grommets of old cable and attaching them to the plows, where they were always in plain sight, so that the unloading cable could be coupled to the grommet without any additional labor. Times was also wasted at first in attaching the cable to and releasing it from the stretching frame, which consisted of two uprights held together and braced spanning the track. A slip link was placed in the chain which held the cable to the stretching frame, and a blow from an iron rod opened this link, allowing the cable to fall upon the car without the train stopping. In this chain there was placed a soft link with a breaking strain of 1½ tons, so that if anything checked the cable in the process of stretching this link would give way and save the cable-stretcher from being wrecked.

In handling material in slides or at other points where it was necessary to uncouple the cars from a train and back them alongside the shovels, the steel aprons that bridged the intervals between the cars were thrown back, in order that the couplings might be parted. In loading, these aprons were frequently covered with a ton or so of soil, and when it became necessary to throw them back in position so that the plow could pass over them, considerable labor was required to take off the spoil. This extra work was obviated by an apron-thrower, which consisted of a short chain with a hook on one end and a cable grip on the other. The hook was placed under the apron and the grip fixed to the moving unloader cable, and thus the apron was returned to its correct position in advance of the plow.

Economy in Use of Fuel Results in Elimination of Dense Smoke

By F. M. LOGAN

Smoke Inspector, Pennsylvania Railroad,
Pittsburgh, Pa.

A NEW FIRE may be built under a stationary boiler without the emission of smoke of a greater density than 20 per cent for a period not exceeding two minutes by placing a layer of coal 10 to 14 in. thick over the grates, sealing the fire-box tight and placing on top of the coal a layer of dry shavings or small pieces of wood, being careful to see that the latter is heaviest along the side sheets of the fire-box. After this has been done a quart of oil should be sprinkled over the wood and a piece of old, greasy waste, about the size of the fist, placed in the center of the fire-box to ignite the fire. After doing this the fire door should be left partly open until the fire is burning, when the door should be closed gradually. The hook or scraper should not be used, but the fire should be allowed to take its own course. On lighting the fire, judgment should be used to prevent too much draft, which might draw the shavings away from the top of the coal. If a damper is being used it should be so regulated that a slight draft is created at the beginning, later increasing as the fire begins to burn. If it becomes necessary to apply more coal this should be dampened and placed over the places that have become bright. This method of building a fire produces considerably less smoke than is allowed by the city smoke-prevention ordinance of Pittsburgh, where the writer's work in increasing the efficiency of firing on locomotive and stationary boilers for the Pennsylvania Railroad has largely been done.

To continue smokeless operation after the fire is built, the coal should be dampened before throwing it on the fire. This prevents any fine coal from passing over the fire, through the flues and out of the stack as unburned carbon. Many are of the opinion that wet coal does not give satisfactory results, but as I have obtained excellent results from the above methods, I do not agree with them. Coal should be fed to the fire frequently and in small amounts, being placed over the bright spots. The hook or scraper should be used as little as possible. Frequent raking of the fire spoils it and wastes a large amount of fuel, at the same time causing clinkers to form on the grates, which condition results in shutting off the air, produces imperfect combustion and makes excessive smoke.

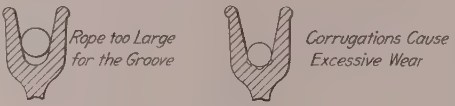
In cleaning fires I have found the best results are obtained by burning down one side of the fire, removing the dirt and clinkers and placing a layer of green coal over the grates. Hot coals should then be thrown over the green coal. The other side of the fire should then be treated in the same manner. If there is no particular haste in building the fire up after cleaning, hot coals should not be thrown on top of the green coal, but the fire should be allowed to burn gradually. If haste is required, the live coals should be thrown so as to cover the green coal on the side that has just been cleaned, during which operation the fire door should be slightly open, in order to admit air and thus aid combustion.

Some years ago, before the adoption of scientific methods in firing, it was a common expression of firemen to say: "If she doesn't make smoke, she doesn't make steam." This era has passed, however, and it has been demonstrated that it is not only unnecessary to make smoke to produce steam, but that better results are obtained when the stacks are free from smoke. Nevertheless, comparatively few owners of stationary boiler plants have as yet carefully studied the details of their boiler operation, although it is no exaggeration to state that those who have are enthusiastic over the results obtained.

[The efficiency obtained by Mr. Logan in firing is as superior to that found in the operation of many contractor's power plants as his methods are different from those of the old-school fireman, still largely represented on construction work. Contractors and master mechanics who have never looked into their boiler operation will do well to follow Mr. Logan's suggestions, proved effective under conditions closely similar to those on construction work.—Editor.]

Large-Sized Drums and Sheaves Give Wire Rope Economy

The best wire rope results are always obtained with large size sheaves and drums. The experience of the A. Leschen & Sons Rope Company indicates that it is important for the grooves to be smooth and of sufficient size so that the rope fits easily without wedging or bending on the side. The accompanying diagram shows the effect of using a rope too large for the groove. When a groove becomes scored it should be turned to eliminate the corrugations. If this is not done shortened rope service will be the result, because of excessive wear done to the uneven surface. Another important point, attention to which prevents undue wear on the rope as well as on the sides of sheaves and drums, is to keep both drums and sheaves in alignment.


Rope too Large for the Groove
Corrugations Cause Excessive Wear

TWO CAUSES OF WIRE ROPE WEAR

Canvas Cover for Concrete Roads Unrolled on Frame from Pipe

The frame shown in the accompanying photograph is used in covering fresh concrete placed on road work. A strip of canvas 19 ft. wide and 50 ft. long is rolled around a length of 2-in. pipe. The frames are then stuck in the shoulder of the road on each side, being supported by the strap-steel stakes shown in the photograph, which are bent around the 2 x 3-in. wood runners of the frame at intervals. Across the road 12 to 14 ft. apart are laid 2 x 3-in. pieces, 17 ft. long, resting on the frames on each side. The canvas around the pipe is then laid across the road and unrolled over the frame.

This device enables the covering to be taken up and reset in a short time, and is especially useful during rainy weather. It keeps the canvas in good condition and prevents its being dragged over the ground or over the green concrete.

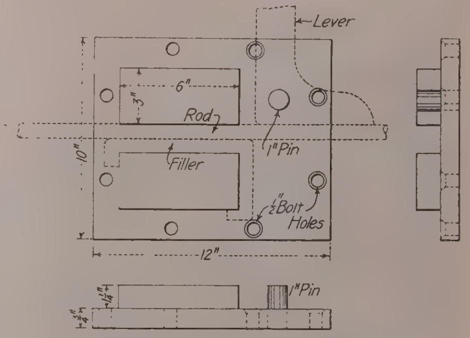
CANVAS PROTECTION UNROLLED FROM PIPE OVER EASILY-SET FRAME

Home-Made Tool Bends Reinforcing Bars of Several Sizes

By R. C. HARDMAN
Colorado Springs, Colo.

A small "home-made" bar bender has been used successfully by the writer for bending cold bars up to 1¼ in. diameter, where not greater than 90 deg. bends were required. The apparatus consists essentially of a cast-iron plate containing two lugs between which the bar is placed, a steel lever fastened to the plate by means of a steel pin about which it acts and a set of fillers, as shown in the accompanying sketch.

The cast-iron plate can be cast of coarse metal in any foundry, the top of the plate with which the lever comes in contact being machined. The bolt holes, certain ones of which must be countersunk to allow free action of the lever, may be either cored or drilled. The space between the two lugs should be slightly larger than the largest size bar to be bent. The filler is a device made of strap iron by any blacksmith, which fits around the lug opposite the lever, to insure a tight fit for bars smaller than the maximum. A set of these to accommodate the various commercial sizes of steel bars can be made at small cost. To insure a good fit the edges of the lug around which the "filler" is placed should be machined. The lever is made of 1 x 2-in. flat steel forged to shape, with the face engaging the bar slightly upset on the upper side. Its length is about four feet.



INEXPENSIVE BAR BENDER

The operation of the apparatus can be readily seen in the sketch, in which the lever, bar to be bent and a filler are shown dotted. The apparatus is fastened to a bench by means of bolts, and countersunk so that the top of the plate is flush with the top of the bench.

Two men can make cold bends under one inch in diameter. On larger sizes three men are required unless recourse is had to a pipe extension to the lever.

The cost of the apparatus should not exceed $12 to $15, and it will readily pay for itself on a small job which will not admit of a more versatile bender.

Page County, Iowa, has had thirty of its highway bridges washed out this season. The expense of making repairs and replacing destroyed structures will total $100,000, according to I. H. Taggart, county engineer.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

To Start Work on $400,000 Waterworks in Cuba

Construction will be started in the near future on the new waterworks system to supply the cities of Caibarien and Remedios in Cuba, the cost of which will be between $400,000 and $450,000.

The supply will be obtained from a series of springs and carried by a gravity line through Remedios to Caibarien. In all there will be about 37 miles of pipe line. The J. G. White Engineering Corporation, as engineers for the Caibarien-Remedios Waterworks Company, will have charge of the work, which will probably be completed within a year.

Caibarien is a city of about 12,000 inhabitants, located on the north shore of the island and is one of the largest shipping ports in the country.

Propose Chicago Branch of American Society of Civil Engineers

Chicago members of the American Society of Civil Engineers met Oct. 28 at the rooms of the Western Society of Engineers to consider and to express a preference for a member of the nominating committee. E. M. Layfield, acting secretary of the Western Society, was unanimously chosen a candidate to represent District No. 5.

A committee was also chosen to look into the desirability of effecting the organization of a Chicago branch of the society. Onward Bates, who presided over the meeting, explained that the Chicago members, although greater in number than in any other city next to New York, because of the absence of any concerted action might have no representation on the board of direction after January, 1916, when C. F. Loweth's term expires.

Tunkhannock Viaduct to Be Put Into Service To-Morrow

Train service over the Tunkhannock viaduct of the Delaware, Lackawanna & Western Railroad, and over the entire 40-mile cut-off of which it is a feature, is to be inaugurated tomorrow, Nov. 7. As stated in the editorial note on page 557, the viaduct is on the Nicholson cut-off in northeastern Pennsylvania, a $12,000,000 change of alignment shortening the road 3.6 miles, eliminating 2440 deg. of curvature and effecting a great reduction in the ruling grades.

There are two monumental reinforced-concrete arch viaducts on the cut-off—the Martin's Creek and the Tunkhannock. The former is 1611 ft. long and 150 ft. high. The Tunkhannock dwarfs even the Martin's Creek, however, and is the largest structure of its kind in the world; it is 2375 ft. long and 240 ft. high, consisting of ten arch spans. The accompanying view of the finished structure, with men and a locomotive on top, gives an idea of its magnitude.

The entire cut-off was built under the general direction of G. J. Ray, chief engineer of the railroad, F. L. Wheaton, engineer of construction, being in immediate charge. A. B. Cohen, concrete engineer, handled the design of the two viaducts. The contractors for the Tunkhannock viaduct were Flickwir & Bush of New York City, F. M. Talbot being general manager.

Conference on Valuation to Be Held in Philadelphia Next Week

A conference on valuation will be held at the Hotel Adelphia in Philadelphia, Nov. 10-12, under the auspices of the Utilities Bureau. According to the tentative program the arrangement of sessions is as follows:

Wednesday, Nov. 10

8.00 p. m.—The Reproduction Theory.

Thursday, Nov. 11

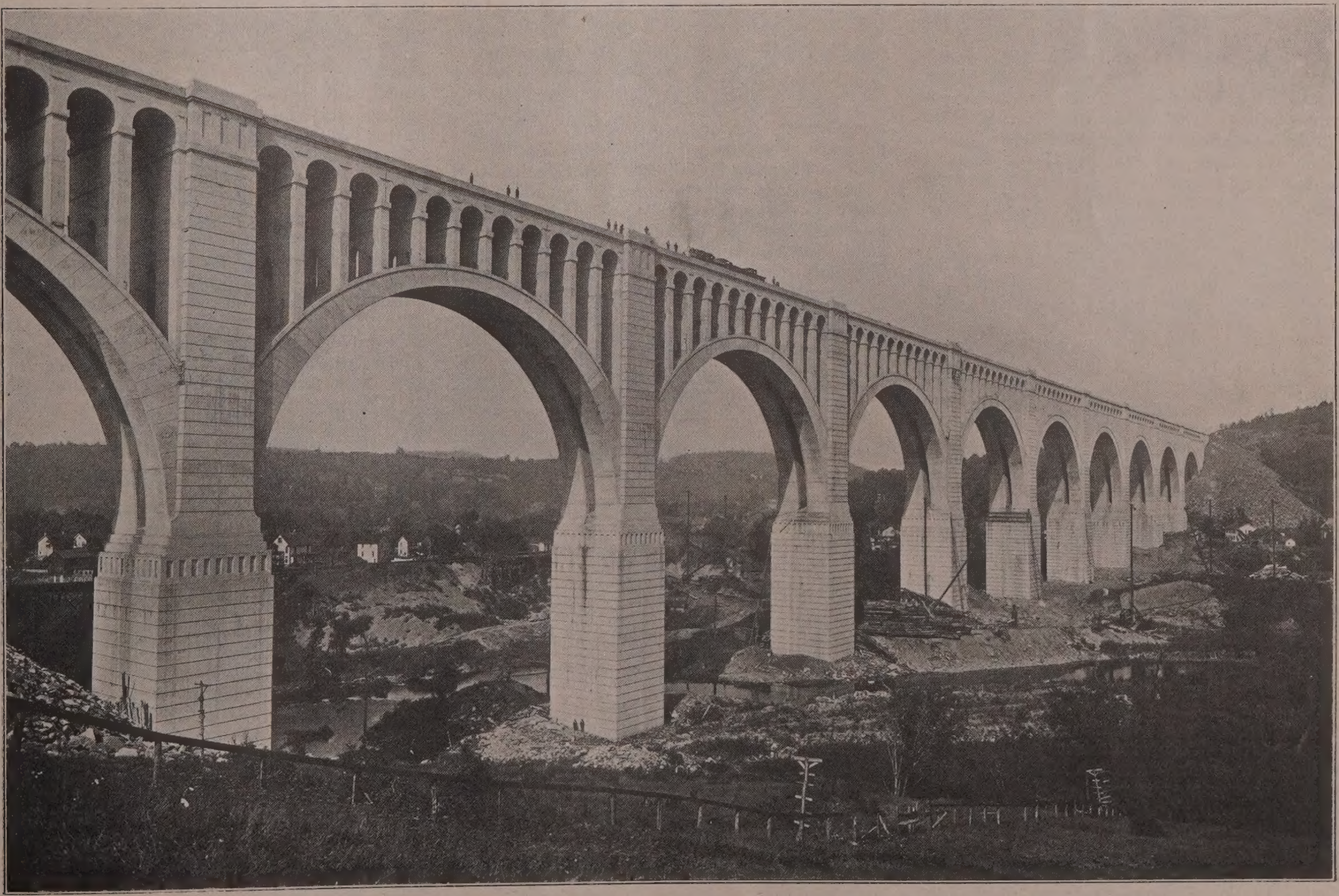
10.00 a. m.—Original Cost.
2.15 p. m.—Franchise Values.
8.15 p. m.—Valuing Land.

Friday, Nov. 12

10.00 a. m.—Depreciation.
2.15 p. m.—Going Value.
6.30 p. m.—Valuation and the Future in Public Utilities.

The program for each session involves formal papers, formal discussion and open discussion. The last session is a dinner, the price being $2 per plate.

Among those scheduled to take part in the addresses or discussions are John M. Eshleman, former president of the California Railroad Commission; Morris Knowles, director of the course in valuation of Public Utilities, University of Pittsburgh; H. P. Gillette, consulting engineer, New York City; Robert H. Whitten, secretary, Board of Estimate and Apportionment, Committee on the City Plan, New York City; Morris L. Cooke, director of public works, Philadelphia; John R. Freeman, president of Manufacturers' Mutual Fire Insurance Company, Providence, R. I.; Hammond V. Hayes, consulting engineer, Boston; Halford Erickson, member of the Wisconsin Rail-



TUNKHANNOCK VIADUCT, THE WORLD'S LARGEST OF REINFORCED CONCRETE, WILL GO INTO SERVICE TO-MORROW road Commission; Leonard Metcalf, consulting engineer, Boston; Clifford Thorne, chairman, Iowa Board of Railroad Commissioners; Charles A. Prouty, director of valuation, Interstate Commerce Commission, and Edward W. Bemis and Milo R. Maltbie, members of the advisory board to the Division of Valuation.

The nine announced purposes of the Utilities Bureau indicate that its mission is to collect, collate and disseminate information relative to municipal utilities. The presence of the word municipal may explain why there is only one scheduled speaker with the railroads' point of view—F. W. Stevens, general valuation counsel, New York Central Lines, New York City. There are three or four representatives of other utility interests listed in a total of thirty scheduled speakers. The program suggests that the conference will have a highly theoretical flavor.

The eight trustees of the Utilities Bureau are as follows: Louis B. Brandeis, counsel for the Interstate Commerce Commission in the Five Per Cent Rate Case; Frederick A. Cleveland, director of the New York Bureau of Municipal Research; S. S. Fels, manufacturer, Philadelphia; Felix Frankfurter, professor of law, Harvard University; Charles F. Jenkins, proprietor of *Farm Journal*, Philadelphia; L. S. Rowe, president of the American Academy of Political and Social Science; Chester H. Rowell, proprietor of the Fresno (Cal.) *Republican*, and Charles R. Van Hise, president of the University of Wisconsin. Dr. Van Hise is president of the board. Morris L. Cooke is acting director.

Germans Awarded Prize in Swedish Harbor Plan Competition

The first prize in the International competition for plans to enlarge its harbor, details of which were given on page 32 of the Jan. 17, 1914, issue of the Engineering Record, was awarded by the city of Helsingborg, Sweden, to the firm of Ludwig Lange, Hanover, together with Marine-Hafenbaudirektor Behrendt, Wilhelmshaven, Germany. Albert Lilienberg and Lieut. N. A. Svenson, Gothenborg, Sweden, were awarded the second prize. The third prize went to Thuresson & Company, Stockholm, Sweden. The judges also recommended the purchase of the following, at $270.00 each: Plans of Prof. R. W. Otto Schulze, assisted by Walter Rouff, Danzig, Germany; those of Ivar Tybjerg, Aalborg, Denmark, and those by Carl Semler and the Contractor Construction Company, Stockholm, Sweden. The harbor department itself decided to buy at the above mentioned figures the projects submitted by Lieutenant Plomann, Stockholm, and S. Ewald, city engineer of Helsingborg, assisted by the architectural firm of Lewerentz & Stubelius.

The time limit of the competition was set for July 15, 1914. The judges met for the first time Aug. 1, 1914, but the work was interrupted the following day by the outbreak of the European war. It was not resumed until Aug. 12, 1915, and it was completed Aug. 24. Because of the unexpected length of time required before results were announced it was decided to increase the prizes and the sums of purchase to the extent of interest for one year at 5 per cent.

American Society National Water Law Committee Meets in Chicago

The special committee of the American Society of Civil Engineers on "A National Water Law" began a meeting in Chicago on Nov. 4, which will terminate to-day, at the rooms of the Western Society of Engineers. The committee consists of the following: F. H. Newell, chairman, professor of civil engineering, Urbana, Ill.; Charles W. Comstock, formerly State engineer of Colorado, Denver; George G. Anderson, consulting engineer, Hollywood, Cal.; Clemens Herschel, New York City; W. C. Hoad, professor of sanitary engineering, Ann Arbor, Mich.; Robert E. Horton, consulting hydraulic engineer, Albany, N. Y.; John H. Lewis, State engineer, Salem, Ore.; Charles D. Marx, president American Society of Civil Engineers, Stanford University; Gardner S. Williams, vice-president American Society of Civil Engineers, Ann Arbor, Mich.

The subject under consideration has to do with the future development and best use of the water resources of the country in municipal and domestic supply, power, irrigation, drainage and stream pollution.

To Hold Pennsylvania Welfare and Engineering Conference Nov. 16-18

The third Pennsylvania Industrial and Public Welfare and Engineering Conference will be held in Harrisburg, Nov. 16-18, under the auspices of the Engineers' Society of Pennsylvania. The industrial exhibit will run most of the week. Governor Brumbaugh of Pennsylvania has instructed all State departments that employ engineers, architects, chemists and inspectors to co-operate with the engineers' society to make the conference a success, and has requested the heads of all such departments to bring in their field men to attend the convention. The committee of arrangements consists of John P. Jackson, State commissioner of labor and industry; F. Herbert Snow, chief engineer of the State Public Service Commission, and Farley Gannet, consulting engineer, of Harrisburg, and president of the Engineers' Society of Pennsylvania. Paul Gendell is director of exhibits. The exhibits will include safety and sanitary appliances, engineering and contractors' equipment and electrical devices.

Defines Violation of New York's Building Code

A new section in the revision of the various articles in New York City's building code, still in progress, has been proposed to define the nature of the violation of the building laws which will constitute a misdemeanor. In article 32, on enforcement, it is to be provided in section 655 that "any person who shall receive and fail to comply with any written peremptory order of the superintendent of buildings issued only when in his judgment an immediate compliance with such order is essential to the public peace or safety, within the time specified in such order, shall be guilty of a misdemeanor."

The amount of the penalty for violation has also been changed from the present $50 to "not less than $10 nor more than $50 as may be fixed by the superintendent of buildings." Similarly, for continued violation after notice the penalty has been changed from $250 to "not less than $50 nor more than $250 as may be fixed by the superintendent of buildings." A hearing was held on these proposed changes on Nov. 4. If they pass the Board of Aldermen, they go into effect immediately.

Los Angeles Water Supply Damage Suit Settled

In the Superior Court of California judgment for the city of Los Angeles was recently entered in the $3,500,000 damage suit by the Natural Soda Products Company. The action involved damages for the alleged diversion of waters of the Owens River. A long and bitter contest was impending until an unexpected offer of compromise was made by the plaintiff, who offered to settle, it is reported, for the sum of about $15,000.

New York Board of Estimate Abolishes Bureau and Committees

In the interests of economy and because their work for the most part has been practically completed, the New York City Board of Estimate, by a vote taken Oct. 27, abolished the bureau of sewer plans and four committees, including that on port and terminal facilities.

Plans for Second Link in Toronto Hydroelectric Radial Indorsed

Plans for the second link in the Toronto (Canada) Hydroelectric Radial System, which will link Toronto with Sarnia and take in all municipalities along the line from Toronto, by way of Guelph and London, were emphatically approved at a gathering of representatives of the municipalities interested in the section from Guelph to London, held in Toronto, Oct. 28. A resolution of approval was moved by the Mayor of London and seconded by the representative from Berlin.

Sir Adam Beck, chairman of the hydroelectric commission, in presenting the plan, pointed out that while the present contract supply of power was about exhausted, the commission had plans before the Government that would allow for the immediate development of 200,000 hp. He further declared that the radials would mean a great saving to the people of Ontario, as they would free them from excessive railway charges. Not only would they give lower rates to those who used them, but, by competition, would compel the railways to reduce their fares.

Utah's State Road Commission Moves Into New Offices

The State road engineer and the State Road Commission of Utah moved into offices arranged for them in the recently completed State Capitol at Salt Lake City on Oct. 30. It is expected that the State engineer will move into the new building very shortly.

Concrete Road Building Sub-Committees Appointed

The sub-committee organization for the Second National Conference on Concrete Road Building, to be held in Chicago, Feb. 15 to 18, 1916, has been completed, and those who accepted appointments on the committees are engaged in preparing their reports. Seventeen general subjects will be covered including: Drainage and preparation of sub-grade; economical width of paving, length and shoulders; problems of design; thickness, crown and grade; aggregates; handling and hauling materials and water supplies; organization of concreting crew; proportions of material and consistency of concrete; mixing and placing; reinforcement; joint location and construction; expansion and contraction; finishing and curing; construction of shoulders and curves; methods and form of maintenance; form of specifications; house construction and estimating, and bridge inspection problems. The chairmen of the committees are: Hector J. Hughes, chairman of the school of engineering, Harvard University and Massachusetts Institute of Technology; J. J. Cox, instructor in civil engineering, University of Michigan; Ira O. Baker, professor of civil engineering, University of Illinois; D. A. Abrams, instructor in charge, structural materials research laboratory, Lewis Institute, Chicago; T. R. Agg, professor in charge of highway engineering, Iowa State College; H. P. Gillette, editor-in-chief *Engineering and Contracting;* W. S. Gearhart, State engineer of Kansas; Ernest McCullough, civil engineer, Chicago; Richard L. Humphrey, consulting engineer, Philadelphia; George A. Ricker, formerly first deputy commissioner, New York State Highway Commission; F. E. Turneaure, dean of the college of mechanical engineering, University of Wisconsin; Charles W. Baker, editor-in-chief, *Engineering News;* A. N. Johnson, highway engineer, Bureau of Municipal Research, New York City; A. H. Hinkle, deputy highway commissioner, Ohio State Highway Department; A. R. Hirst, State highway engineer, Wisconsin Highway Commission; C. J. Bennett, State highway commissioner of Connecticut, and A. Marston, dean and director, division of engineering, Iowa State College.

Rhode Island Board of Public Roads Issues First Bulletin

With the purpose of describing the work done upon State highways during 1915 and of outlining in brief the ideas it entertains for work in the future, the Rhode Island State Board of Roads has commenced the publication of the *Rhode Island Highway News*, a bulletin designed to acquaint the public with the work of the department in a way that would be impossible in the regular annual report.

The first issue contains fifteen pages of text, profusely illustrated and written up in interesting style. The pictures are well selected and instructive. Methods of construction are described and the problems before the board are frankly discussed.

Calgary Entertains Engineers Returning from San Francisco

About fifty engineers, returning from the International Engineering Congress in San Francisco by the Canadian route, were entertained at Calgary, Alberta, by the Calgary branch of the Canadian Society of Civil Engineers and the city authorities. Points of engineering interest were visited and a luncheon was given in the visitors' honor. The engineers of the city, aided by the Canadian Pacific Railway Company and the citizens of Bassano, provided a dinner and a visit to the Bassano dam, a part of the big irrigation project of the Canadian Pacific Railway. An attractive booklet describing some of the features of engineering interest in the vicinity was issued.

If You Want a License Without Examination Apply Now

To obtain a structural engineer's license in Illinois without examination application must be made before Jan. 5, 1916, according to a notice being sent out by the Western Society of Engineers. Requests for application blanks and copy of the laws should be addressed to the Illinois Board of Examiners of Structural Engineers, 1735 Monadnock Block, Chicago.

San Francisco-Oakland Terminal Consolidates Departments

The departments of Maintenance-of-Way and Structures and of Docks and Wharves of the San Francisco-Oakland Terminal Railways have been consolidated under the name of Department of Way and Structures. The Docks and Wharves department was created early in 1914 to facilitate the extensive works undertaken by the company in San Francisco Bay, which are now nearing completion.

Scientific Congress Outlines Work of Engineering Section

The engineering section of the Pan-American Scientific Congress to be held at Washington, D. C., from Dec. 27, 1915, to Jan. 8, 1916, will treat of such subjects as relate to water and land transportation and various other problems of interest to the engineering sciences, such as a common Pan-American body of engineering nomenclature and laws regulating the use of water. The chairman of the section is Brig.-Gen. W. H. Bixby, U. S. A., retired. Dr. E. L. Corthell is secretary. Among others included in the membership of the section are: Capt. C. A. McAllister, engineer in chief, U. S. Coast Guard; Lieut. Col. E. E. Winslow, corps of engineers, U. S. A.; Col. W. W. Harts, U. S. A., in charge of the Office of Public Buildings and Grounds, Washington, D. C.; A. P. Davis, director and chief engineer, U. S. Reclamation Service; R. B. Marshall, chief geographer, U. S. Geological Survey; L. W. Page, director, U. S. Office of Public Roads; S. W. Stratton, director, Bureau of Standards, Department of Commerce; E. Lester Jones, superintendent, U. S. Coast and Geodetic Survey; Major C. W. Kutz, Corps of Engineers, U. S. A.; Charles Warren Hunt, secretary, American Society of Civil Engineers, and Col. L. H. Beach, Corps of Engineers, U. S. A. General William C. Gorgas has been appointed chairman of the Public Health and Medical Science section of the Congress.

First Through Train Over Canadian Northern Pacific

The first through train over the line of the Canadian Northern Pacific Railway left Montreal, Que., on Oct. 12 at 5 p. m., and arrived in Vancouver, B. C., early on the morning of Oct. 19. The trip was made as an inspection of the line preliminary to the inauguration of regular service on Nov. 1, which commenced with a through passenger train service of three times a week. On the special train were twenty members of the Canadian Senate, fifty members of the House of Commons and thirty newspapermen.

The last spike in the new transcontinental line was driven at Basque, B. C., 182 miles east of Port Mann on Jan. 23, 1915. The system opened its first line in central Manitoba in 1896, and now has in operation approximately 10,000 miles of single track.

News of Engineering Societies

The Southwestern Waterworks Association will hold its annual convention at Waco, Texas, May 8-10, 1916. These dates were decided upon at a meeting of the executive committee, held in Dallas, Oct. 25. E. L. Fulkerson of Waco is secretary of the association.

The Engineers' Club of St. Louis heard F. G. Jonah, chief engineer of the St. Louis & San Francisco Railway Company, speak on "Suggested improvements in the Terminal Situation in St. Louis," at a meeting held in that city Nov. 3.

The Municipal Engineers of the City of New York will make an inspection of the Newark meadows land reclamation and harbor improvement work to-day.

The Western Society of Engineers has arranged the following program of meetings for November: Nov. 2, "The Railroads and the Public," by L. E. Johnson, president Norfolk & Western Railroad; Nov. 8, "Design of a Railroad Pontoon Bridge," H. J. Hansen, Chicago, Milwaukee & St. Paul Railway; Nov. 22, "Street Railways," Leonard A. Busby, president Chicago Surface Lines; Nov. 29, "The Use of Influence Lines" and "The Deflection of Trusses," by R. W. Flowers and E. H. Casper, both of the American Bridge Company.

The Association of Urban Universities will hold a conference on co-operation between cities and universities in training for public service at Cincinnati, Nov. 15-17.

Personal Notes

FORD KURTZ has been appointed resident engineer for the J. G. White Engineering Corporation, engineers for the Caibarien-Remedios Waterworks Company of Caibarien, Cuba, on the construction of that company's water supply system at Caibarien.

P. W. HAVERSTICK, formerly transitman in the office of the engineer of maintenance-of-way of the Pennsylvania Railroad System, has been appointed assistant supervisor of the Conemaugh division, at Verona, Pa. He was graduated from Pennsylvania State College in 1907 and entered the service of the Pennsylvania in 1908. He was appointed transitman in 1914.

LOUIS K. ROURKE, formerly assistant division engineer of the Central division of the Panama Canal and recently commissioner of public works of the city of Boston, and Edward C. Sherman, formerly division engineer on the Charles River dam and lock at Boston, later designing engineer on the Panama Canal, and, for the past four years, in private consulting practice, have associated themselves under the firm name of Rourke & Sherman to conduct a general consulting engineering practice, occupying offices at 6 Beacon Street, Boston. They will give special attention to organization, to the design, construction and operation of public works, including river and harbor improvements, refuse disposal, water supply, sewerage and pavements, railroad work and to Spanish-American projects.

EDWARD M. BOGGS, formerly chief engineer of docks and wharves of the San Francisco-Oakland Railways, has been appointed chief engineer of the recently created department of way and structures of that road. He entered railway service in 1881 as chairman in the engineering department of the Columbus, Hocking Valley & Toledo. In 1886 he was appointed resident engineer in charge of the construction of 11 miles of railway in the Rocky Mountains for the Colorado Midland. As engineer for the town of Cascade, Cal., in 1881, he laid out the original town site and planned a water system. From that year until 1892 he engaged in private practice in San Bernardino, Cal., and Redlands. From 1892 to 1897 he was professor in civil and hydraulic engineering at the University of Arizona. He received the degree of civil engineer from that university in the latter year. He left this work to become chief engineer of the Southern California Power Company of Redlands, Cal., in which capacity he designed and constructed the hydraulic works in Santa Ana cañon. In 1899 he returned to private practice. In 1902 he was appointed chief engineer of maintenance-of-way and structures of the San Francisco-Oakland Terminal, which office he occupied until 1914, when the department of docks and wharves was created in order that he might devote his attention exclusively to the extensive works the company had under construction in San Francisco bay.

I. B. FUNK has resigned from the office of city engineer of San Fernando, Cal.

FRANK P. KEMON, formerly general superintendent for the Duquense Contracting Company of Pittsburgh, has been appointed general superintendent for the Sutton & Corson Company of Ocean City, N. J., in charge of the construction of a sewage disposal plant and 8 miles of intercepting and outfall sewers for the town of Avalon, N. J. As superintendent of construction for the Millard & McGraw Company of Philadelphia, Mr. Kemon had charge of the construction of the Waverly transfer for the Pennsylvania Railroad at Waverly, N. J., and a 5-mile section of the New York Short Line, including the four-track concrete bridge across Neschaminy Falls, besides other construction for the same railroad. As superintendent of concrete masonry for the Carter Construction Company of Chicago, he had charge of the construction of concrete structures on the Lake Erie & Pittsburgh, including a bridge across the Chauyoga River, and an 11-mile section of grade revision on the Cincinnati, Hamilton & Dayton, which included a reinforced-concrete arch bridge across the Great Miami River. From the Carter Company he went to the Duquesne Contracting Company, where he had charge of the construction of an addition to the Pittsburgh waterworks filtration plant at Aspinwall, Pa., as well as a considerable amount of railroad construction.

GEORGE H. BINKLEY has resigned from the office of chief engineer of maintenance-of-way and structures of the San Francisco-Oakland Terminal Railways. He was appointed to office in the early part of 1914.

Henry Goldmark, consulting engineer, of New York City, has been retained to take charge of the fabrication, in the United States, of the lock gates, sluice valves, operating machinery and electrical equipment for the large tidal lock which will give access to the new harbor at Chemulpo, Korea. The work is to be done in accordance with competitive plans prepared by Mr. Goldmark for the McClintic-Marshall Company of Pittsburgh, successful bidders on the entire equipment, which were adopted by the harbor authorities.

S. E. Stewart, formerly transitman in the office of the engineer, maintenance-of-way of the Pennsylvania Railroad System, has been appointed assistant supervisor on the Tyrone division. He was graduated from Ohio Northern University in 1909 and entered the service of the Pennsylvania as rodman on the Elmira division in 1910.

Horatio V. Nye, at one time U. S. examiner of surveys and, until recently, engineer and assistant superintendent of the Northwestern Consolidated Milling Company of Minneapolis, Minn., has been appointed assistant secretary and sales manager of the Southwestern Milling Company of Kansas City.

H. D. Stowe, formerly supervisor for the Pennsylvania Railroad System at Dunkirk, N. Y., has been appointed pilot engineer in the office of the valuation engineer. He was graduated from Yale University in 1902, and took a position as rodman in the office of the principal assistant engineer of the Pennsylvania System at Buffalo, N. Y. In 1905 he was transferred to Altoona, Pa., as transitman and, in 1906, was appointed assistant supervisor at Bordentown, N. J. He attained the grade of supervisor in 1911 and was transferred, in that capacity, to Dunkirk in 1913.

G. W. Curtis, formerly supervisor for the Pennsylvania Railroad System at Shamokin, Pa., has been appointed pilot engineer in the office of the valuation engineer. He was graduated from Princeton University in 1902 and entered the service of the Pennsylvania System, in July of that year, as rodman in the office of the assistant engineer of the Pittsburgh division. In 1905 he was transferred to Altoona and promoted to the grade of transitman. In 1906 he was advanced to the grade of assistant supervisor of the Amboy division. He was appointed supervisor at Shamokin in 1912.

James Cole Roberts of the U. S. Bureau of Mines has been appointed to the Joseph Austin Holmes Professorship of Safety and Efficiency Engineering at the Colorado State School of Mines.

Ralph H. Stearns, formerly designing engineer for the Board of Water Commissioners of the City of Hartford on the Nepaug water supply project, has been appointed assistant engineer on the forces of the Water Supply Board of Providence, R. I. Mr. Stearns was graduated from Massachusetts Institute of Technology in 1901 and served as rodman for the Metropolitan Sewerage Commission of Massachusetts until 1902, when he was appointed transitman for the Boston Transit Commission on the construction of the East Boston tunnel and on the studies of the Washington Street tunnel. In 1904 he was promoted to the position of assistant engineer on the latter work. From this position he went to the New York City Board of Water Supply, where he served as assistant engineer designer on the Catskill Aqueduct work. With the Hartford board of water commissioners he had charge of the design of all structures included in the Nepaug supply system, including a 9,000,000,000-gal. reservoir, a 42-in. cast-iron pipe line, 36,660 ft. long, 3667 ft. of concrete conduit and 2333 ft. of tunnel. He completed his work on this project in 1914, since when he has been engaged in consulting practice in Boston.

A. W. Macpherson has been appointed assistant chief engineer of the department of way and structures of the San Francisco-Oakland Terminal Railways, with headquarters at Oakland.

Edmund S. Higgins has been appointed maintenance engineer for E. I. duPont de Nemours & Company, manufacturer of high explosives, of Wilmington, Del., at City Point, Va.

Henry L. Collier, formerly consulting engineer of the Yellow Pine Manufacturers' Association of St. Louis and, previous to that, for many years commissioner of public works at Atlanta, Ga., has opened offices in the Candler Building, Atlanta, to engage in practice as consulting engineer, specializing in pavements, concrete construction and land lines and boundaries. Mr. Collier was graduated from the University of Georgia in 1872 and first engaged in engineering work as assistant resident engineer for the Georgia Western Railway. In 1874 he was appointed instrumentman on the U. S. Government survey of a double-track railroad from Gunter's Landing, on the Tennessee River, to Brunswick, Ga. In 1876 he served as engineer in charge of the location of the Toccoa & Elberton Railroad, which is now a part of the Southern Railway System. From 1878 to 1879 he was again in the Government service and from 1880 to 1881 he was division engineer with the Georgia Pacific. In 1882 he was appointed chief engineer in charge of location and construction of the Gainesville, Jefferson & Southern. From 1887 to 1889, as chief engineer of location and construction of the Atlanta & Florida, he located that line from Atlanta to Madison, Fla., and constructed it from Atlanta to Fort Valley, Ga. In 1890 he was engaged in contracting and, from 1891 to 1892, he was general manager of the granite quarries at Lithonia, Ga. He became examiner of surveys for the U. S. Government in Wyoming, Idaho, Oregon, Washington, Utah, Nevada and California in 1893 and served in that capacity until 1898, when he was appointed chief engineer of the Tifton & Moultrie Railroad in Georgia. In 1900 he was appointed chief engineer in charge of location and construction of the Georgia & Florida Railroad a second time. He was appointed commissioner of public works of Atlanta in 1901 and consulting engineer for the Yellow Pine Manufacturers' Association about four years ago.

William Goldsmith has resigned from the position of superintendent of the Borough of Manhattan, New York City, municipal asphalt plant to accept a position as engineer in charge of construction of the New Hampton Farms Reformatory for the Department of Correction, New York City. The work will involve an expenditure of about $800,000 and will include a railway line, a water supply and sewerage system, a power plant and various buildings.

G. W. Smith, formerly assistant superintendent for J. G. Cordner, architect, of Lincoln, Neb., on the foundation work for the new Ford automobile assembly plant at Omaha, Neb., has been appointed architectural engineer for the Hodgin Construction Company, general contractors, of St. Paul, Minn., who have the contract for the building and also for the new plant for the same company at Oklahoma City.

H. W. Eckel, formerly borough engineer of Washington, N. J., and, previous to that, resident engineer on the Coquahalla division of the Kettle Valley Railway in British Columbia, has joined the engineering staff of the Taylor-Wharton Steel Company and is located at High Bridge, N. J. Previous to his work at Washington, Mr. Eckel spent a year in the Nome district, Alaska, engaged in prospecting and mineral surveys, and three years in British Columbia on railroad construction, his last work in that line being the Kettle Valley work.

Louis C. Brown, formerly resident engineer for the L. A. Boulay Engineering Company of Toledo, Ohio, on paving work at Mount Victory, Ohio, has been appointed resident engineer for W. J. Sherman, consulting engineer of Toledo, on the Sylvania (Ohio) waterworks improvements, construction of which will be started in the near future.

G. W. Bass, formerly water purification superintendent for the Central Illinois Public Service Company, at Lawrenceville, Ill., has been appointed deputy health commissioner in charge of the Porter County Health Laboratory at Valparaiso, Ind.

R. H. Pinkham, formerly assistant supervisor for the Pennsylvania Railroad System at Derry, Pa., has been appointed division engineer of the Renovo division. He was graduated from Massachusetts Institute of Technology in 1899 and entered the service of the Pennsylvania in 1901 as levelman in the office of the engineer of maintenance-of-way. About two months later he was promoted to the grade of transitman in the office of the principal assistant engineer at Altoona, and, in 1902, he was appointed assistant supervisor at St. Mary's, Pa. He was transferred to Derry in the same capacity in 1912.

J. F. Rehn, formerly chief engineer and general superintendent of Cementos Hildago, at Hildago, Mexico, has been appointed engineer in charge and superintendent of the Nebraska Portland Cement Company, with offices at Superior, Neb.

Alfred P. Bosworth, formerly connected with the engineering forces of the California State Highway Commission, in the San Francisco and Fresno offices and on construction, has been appointed city engineer of Tulare, Cal. This is a new office combining the offices of superintendent of streets, superintendent of sewers and superintendent of waterworks. Mr. Bosworth was with the State highway commission for four and a half years. Previous to that he was, for two years, with the department of revaluation of the Southern Pacific Railroad.

T. K. Minsker, formerly assistant supervisor for the Pennsylvania Railroad System at Bowie, Md., has been appointed supervisor of the Buffalo division at Dunkirk, N. Y., succeeding H. D. Stowe, whose appointment to another office is noted elsewhere in these columns. Mr. Minsker was graduated from Lehigh University in 1903 and entered the service of the Pennsylvania in July of that year as rodman on the Chautauqua division. He attained the grade of transitman in 1906 and that of assistant supervisor later in the same year.

F. X. Bradley, formerly assistant supervisor for the Pennsylvania Railroad System at Derry, Pa., has been appointed supervisor of the Allegheny division, at Salamanca, N. Y. He entered the service of the Pennsylvania in 1903, as rodman in the office of the principal assistant engineer at Williamsport. He was promoted to transitman in 1906 and became assistant supervisor in 1909.

H. P. Thomas, formerly assistant supervisor for the Pennsylvania Railroad System, at Tacony, Pa., has been appointed supervisor of the Middle division, at Hollidaysburg, Pa. He was graduated from Haverford College in 1905 and entered the service of the Pennsylvania as rodman on the Belvidere division in the same year. He was promoted to the grade of transitman in 1908 and to that of assistant supervisor in 1909.

Harvey W. Hincks of Los Angeles, under whose supervision the Modoc Point Irrigation project and the Sprague River dam were recently completed, has been promoted from assistant engineer in the U. S. Indian Irrigation Service to engineer in charge of the irrigation work on the Klamath Indian Reservation, with headquarters at Chiloquin, Ore.